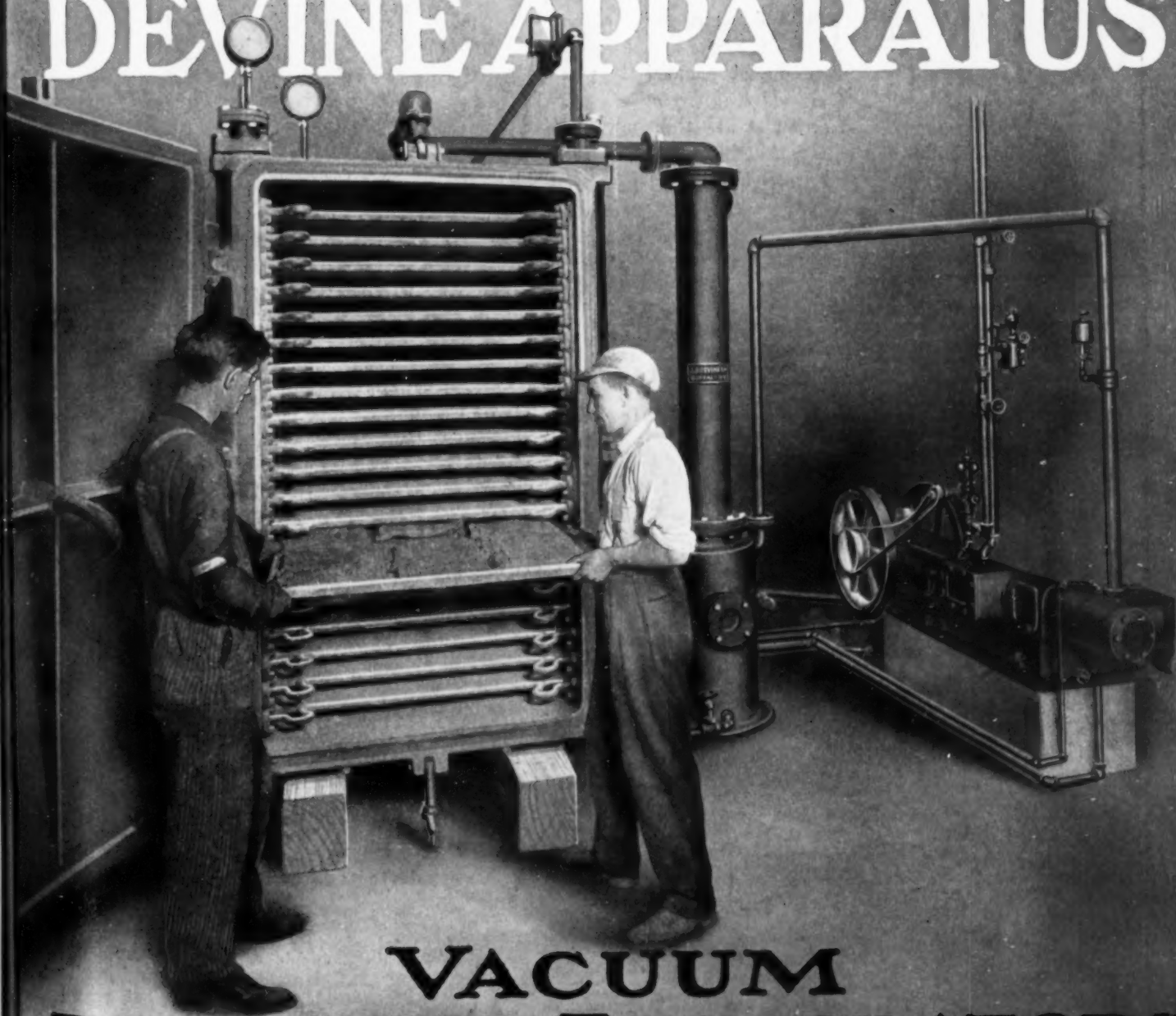


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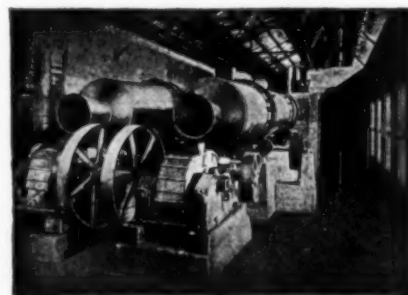
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Mr. Lane

Points the Way

IN HIS letter of resignation as Secretary of the Interior the Hon. FRANKLIN K. LANE wrote to the President as follows:

"In parting, let me say a general word as the fruit of my experience here. Washington is a combination of political caucus, drawing room and civil service bureaus. It contains statesmen who are politicians and politicians who are not statesmen. It is rich in brain and in character. It is honest beyond any commercial standard. . . . But it is poorly organized for the task that belongs to it. . . . Ability is not lacking, but it is pressed to the point of paralysis because of an infinitude of details and an unwillingness on the part of the great body of public servants to take responsibility.

. . . We have so many checks and brakes upon our work that our progress does not keep pace with the nation's requirements. We could save money for the Government if we had more discretion as to how we should use that given us. . . . As matters are now devised there are too few in the Government whose business it is to plan. Every man is held to details, to the narrower view, which comes too often to be the department view or some sort of parochial view. We need for the day that is here and upon us . . . more opportunity for planning, engineering, statesmanship above, and more fixed authority and responsibility below."

These are words of wisdom. In somewhat the same line of thought the Hon. FRANK O. LOWDEN, Governor of Illinois, said at a meeting in Brooklyn the other day that while industry has advanced within the last century to meet new conditions, the art of government had stood still. In some respects it had gone backward. We have bureaus and commissions by the hundred, and these overlap in function, but lack correlation. We have no department of public health, and yet there are about forty-two bureaus in Washington that relate to it. On taking office in Illinois he found a great number of commissions, and commissions are usually given to discussion rather than to action. In co-operation with the Legislature they succeeded in superseding the commissions with nine departments of government—and no more—with one man at the head of each, and he is made responsible for its conduct. The head of the Department of Finance has no other obligation, but he can withhold disbursements even of money appropriated if he does not believe the expenditure is proper. The appeal over such a decision is to the Governor. In the United States Government all departments are spending departments. Even the Secretary of the Treasury is loaded with administrative details—such as the United States Coast Guard, Public Buildings, etc.—and appro-

priations for all departments may be spent in full without check. Unless our wasteful methods are reorganized, taxation will constantly grow, and with the present burden, if we run into bad times, it will take us a very long time to overcome them; because no one will venture expenditures for new enterprises with the increased hazard of loss and the certainty of taxation if profits ensue.

This sounds right to us also. The fact is for nearly 150 years we have been run by politics in affairs of government, and politics have failed. We are growing impatient under the inefficiency of political administration. We are sick and tired of politics, although we must have them, just as we must have boots and shoes. But just as we do not want to restrict our lives and thoughts to boots and shoes, so we do not want our government to consist of politics and nothing else. The inefficiency of both Republican and Democratic Congresses of the United States for many years past is a thing to be ashamed of. We have not the patience to listen to the men who "point with pride" to the achievements of any of them. We want to hear of opinions and plans without any fireworks. That letter of HERBERT C. HOOVER to his friends probably did not please the politicians. They were not used to it. They want points to yell over, and this was modest but earnest. To us it appealed as the very attitude of mind which we long for in our representatives in government.

Practicing Industrial Good-Fellowship

THERE is more merit than fault (until the habit becomes a nuisance) in the man who stands up for his home town and district. The trouble is that in our patriotic boasting we may confine ourselves to the talking points that we have learned, and mere recitations often lose weight and even interest in discussions among the thoughtful. Thus a vapid, fat, lazy, inert man of the East, who cannot see the difference between an inch and a centimeter, is likely to make the observation with half-closed eyes, between the puffs of his cigar, that a man from the West is unable to perceive the fine distinctions which are clear to his brother of the East. And a similarly undesirable person from the West sometimes offends with the assertion that because a man is from the East he must perforce lack vision and understanding. Such persons give us a pain in the mind.

On the other hand we may observe traditions and habits that have developed in various parts of the country which are, in a way, sectional and it is to a certain conflict of habit in industry between the East and the West that we now desire to call attention.

When the late Dr. JAMES DOUGLAS undertook to engage in smelting copper, he was modest enough to be-

lieve that he did not know everything there was to be known on the subject. He caught, let us say, the air of the great plains and the big hills, and he thought large. He felt that no matter what his part in it might be, the American copper industry was a thing in itself, and the more it prospered the better it would be for all concerned. He was scrupulous in the defense of the interests for which he was responsible, but as an artist in smelting copper he wanted to learn as much as he could, and he was enough of a psychologist to know that the way to learn is to tell. So he kept open house for metallurgical engineers and, since turn about is fair play, others made him welcome also.

The Western copper mining and smelting industry grew by leaps and bounds, and its traditions of hospitality remain to this day. Occasionally an engineer or metallurgist of one of the great establishments in Montana or Arizona goes on a vacation for a month or so, and instead of coming to New York to analyze Broadway it is probable that he will go where competitive operations are in progress and visit his brother engineer or metallurgist. Everything is open to him. He finds some new wrinkles that he resolves to adopt, and he tells his friend how he or his staff has conquered difficulties that still loom large in the eyes of his host. The patentable ideas in industrial improvement are far fewer than those that are not patentable, and as a result of this friendly visit the stockholders of both concerns may profit. There is no tragedy in the accretion of profits by competitors.

We have not reached the last word in metallurgy, by any means, but just because of this open-mindedness and give-and-take quality of Western engineers they have ventured to build much larger units and they have succeeded in producing metals with far greater economy than if everyone had worked in secret and been limited by his own imagination and technical experience. It is fair to say that industrial good-fellowship has contributed largely to the American copper industry.

This tradition is less developed in the East in chemical industry. We have in mind two engineers who came from the West and were engaged as respective managers of competitive works making a standard product. They had worked together in a friendly way in the West and were familiar with the tradition of industrial good-fellowship. One of them was even imbued with the belief that this tradition might find a welcome in the East. He had trouble with a certain step in a process and was about to post off to his friend to confer with him about this and other methods of procedure. He planned, as usual, to match his experience with that of his friend and to see how conditions and quality and yields might be improved. He had some ideas that he hoped to try out, but he wanted first to talk them over with someone competent by education and experience to advise with him. The directors got wind of his intention and they proceeded to throw fits. Their manager was about to confer with their greatest competitor and thought to give away all their secrets! (The competitive corporation in the meantime was doing very well, thank you, with its secrets.) Such a breach of sound business methods had never been heard of by the board, and the manager was informed, with such charity and patience as should be employed with innocent offenders, that he must not go. He had better not, they said in their abundant caution, even associate with his friend. If he

could get the information desired without giving anything in return, that would be desirable, but he must bear in mind that the hazard of letting information as to their establishment slip out was to be avoided. On the other hand, if he could manage to lure away some employees that worked under his friend, this would find favor with them, and they were even prepared to make a special appropriation to accomplish it.

Here they struck a snag. The poor fellow suffered from inhibitions. He had grown up to believe that it was contrary to professional ethics to hire away employees from other works, and he would not even try to do so.

He is a chastened man, and the directors continue to direct—which is as it should be. Directors should direct or get out and give way to men who know enough to do so. But as we have intimated before, one of the greatest needs of chemical industry in America is resignations or obituary resolutions among the boards of directors of a considerable number of establishments.

Technicalities

Concerning Alcohol

ALCOHOL has long been distinguished by marked legislative attention, having been revenue and licensed for years and years and finally regulated to such a degree that only those proficient in law could make out exactly what rights still belonged to it. Even in regard to these, our most noted lawyers find scores of technicalities of a pro and con variety. As an illustration, take the brief of the law firm of ELIHU ROOT endeavoring to persuade the Supreme Court that the Eighteenth Amendment to the Constitution, which made national prohibition possible, was not legally adopted and is therefore invalid. Mr. ROOT contends that this method of legislation is novel, not supported by precedent and is distinctly opposed to proper procedure. Also the amendment "directly and substantially" tends toward the "destruction of the right of the several states to local self-government" and interferes with the taxing and police powers of the state.

It is a humorous incident that Congress in proposing the amendment left out the usual preamble advising the states that two-thirds of both houses of Congress deem the amendment necessary, which, by the way, ought to set an excellent example to those concerned with the enforcement of the law. Also the length of red tape to which users of industrial alcohol must submit ought to be beneficially influenced by this practical precedent in Congress. It is at least hoped that the preambles and other extravagant time-consuming non-essentials will not continue to play a predominant part in matters pertaining to industrial alcohol regulations.

New regulations for the alcohol industry have recently been enacted and a concise interpretation will be found on another page in this issue. A careful study is recommended to those who are in any way concerned with industrial alcohol, not only for their present guidance but to determine what changes can be made in future regulations to lighten the burden on the users of it in industry without impairing the effectiveness of the prohibition law. The Government is clearly on record as being desirous of promoting legitimate uses of alcohol. It remains for industry to co-operate with the Government in order to determine and put into effect regulations which will be satisfactory to all concerned.

Users should bear in mind that at present only four denatured alcohol mixtures are free from both governmental regulations and taxes and may be sold, distributed and used without any restrictions. The ten-part-wood-alcohol mixture has been withdrawn because of the great number of deaths caused by its use as a beverage. The courts have decided to hold for trial all parties found responsible in wood alcohol poisoning cases, and heavy sentences have been imposed on all those convicted. Nevertheless other denaturants, such as certain petroleum distillates, pyridine, nitrobenzol, sulphuric ether, etc., are more than filling the gap made by removing the ten-part-wood-alcohol product from the open market. It is hoped, however, that better formulas will be developed that will give the public a less obnoxious denatured alcohol, at once fool-proof and nonpotable.

While all authorized denatured alcohols are tax free, pure ethyl alcohol is allowed to go tax free only under bond and regulations, and only to those who make scientific application of it. Special care must be taken to prevent thefts and resultant misapplications, the occurrence of which results in the \$4.18 tax being collected from the bond. There is no more ingenious burglar than the alcohol thief. He has been known to bore through the floor of a car or room right into steel drums, if necessary, to secure his prize. Desire is the mother of ingenuity.

The Steel Industry Can Function

F EARS entertained, or at least expressed, last December, that the iron and steel industry would not be able to function well this year, or at least during the early months, are now largely dispelled. The change in viewpoint is partly psychological, and therefore carries a favorable augury for other industrial activities of men. During the war the feeling was, "It can be done," but after the war there seemed to come a feeling, "It can't be done." There was always something claimed to be in the way. Since the steel industry was formerly noted for its sanguine temperament, its more courageous viewpoint at this time may be expected to be followed by a better feeling all around in industry.

The steel industry was afraid it would not have enough labor, or that if it had labor the men would not know how to work or would not be willing to work, and fears were also expressed that there would not be enough transportation, particularly for coal and coke. In January there was little complaint of labor shortage and not much of labor inefficiency, yet throughout the month there was much complaint of car shortages, affecting the movement of beehive coke, of coal for byproduct ovens and steel plants and of intermediate and finished products. Yet when records were compiled it was found that pig-iron production in January was 14 or 15 per cent greater than in December, and steel ingot production was 83 per cent of capacity, taking capacity at 49,000,000 tons a year. In December some mills had predicted that they would not be able to average more than about 75 per cent production during the first quarter of the new year, this being based on assumptions of a lower rate than that in January and of a higher rate in March.

The actual test of operation has furnished some other

surprises, or divergences from prognostications. During the war there was heavy new construction of open-hearth steel furnaces, whereby a common estimate was that steel ingot capacity was increased by 40 per cent during the war, from about 35,000,000 tons a year at the beginning of 1915 to about 49,000,000 tons in 1919. Then it was asserted that steel-rolling capacity had not been increased correspondingly, hence at the close of the war, with the manufacture of shell steel, involving little rolling, discontinued, the steel industry would find itself capable of making more steel, in ingot form, than it could finish. Unfinished steel would therefore be found relatively plentiful and finished steel relatively scarce.

Nothing of the sort has developed. Ingots have not been offered in the market at all. Blooms and billets have been scarce and have brought very high prices relative to the average prices at which finished steel has been delivered. The circumstance is the more remarkable from the fact that the demand for finished steel as a whole has not followed the usual analysis or distribution among the various finished products. With such conditions, unfinished steel should be abnormally plentiful, through some finishing departments being unable to supply the demands upon them and other finishing departments having an especially light demand for their particular forms of product.

Another prediction made before the close of the war was that sheet rolling capacity would be found insufficient to the demand, because so few sheet mills had been built during the war. In the last analysis such a condition might be proved, theoretically, to exist at present, but the actual experience in the trade in the past few weeks has been of sheet consumers bidding up prices of sheet bars, purchasing any lots they could secure, and experiencing no difficulty in finding sheet mills with reserve capacity, ready and anxious to make conversion contracts to turn consumers' sheet bars into sheets for them. The fancy prices have been paid not for the conversion of the bars into sheets, but for the sheet bars themselves.

Again, there was argument as to the supply of basic pig iron. It was maintained in some quarters that there had been so much new construction of basic open-hearth furnaces that basic pig iron would be made extremely scarce, while one rejoinder was that the scarcity might not occur, because the steel mills would experience a greater scarcity of labor than the blast furnaces, whereby the steel mills would not be able to consume pig iron in proportion to their physical capacity. Pig iron did become scarce, it is true, and prices advanced rapidly, but the advance was led by foundry iron, not basic, the basic grade for a long time trailing far behind foundry iron in the matter of price.

These and other observations that could be made all make the same showing—that the steel industry really can function, and function well. It can operate in circumstances that were claimed would present insuperable obstacles. The industry should now take on fresh courage, forget theoretical obstacles, and bend all its energies toward building up markets, rendering service to consumers, producing its material at the lowest possible cost and encouraging consumption by selling its output at the lowest margin consistent with a fair return upon the capital and effort involved in production.

Readers' Views and Comments

Mr. Hoover and the Presidency

To the Editor of Chemical & Metallurgical Engineering

SIR:—In view of the notes you have published recently regarding Mr. Hoover and the Presidency you may be interested in giving your readers an opportunity to get a little deeper insight into the man and his history. The accompanying quotation is reported to be from a letter written by Mr. Hoover to Casper W. Hodgson, a Stanford classmate, and is taken from a recent issue of the *New York World*.

It discloses the saving grace of humor so essential to the peace of mind of those who become popular subjects of conversation.

I have noted your feeling that I should answer some of the solemn discourses on my private life and crimes. I do seem to get into the way of politically minded folks even when trying to keep out of politics.

Some things that have been said of me cause me a sense of financial oversight. For instance, I have made quite careful inquiries and I regret that so far I cannot find—

(a) The \$10,000,000 I am said to have made in my early youth, or even middle age, or altogether, or any respectable part of it.

(b) The investments that I am supposed to have in Great Britain.

Like the negro porter who was asked to change \$10, I am grateful for the compliment. I am sorry that these sums do not exist, for they would be useful for Children's Relief.

I have also given deep consideration to the other items mentioned:

(a) Am I a British subject? Did I ever apply for such citizenship? No. Many generations of persecuted Quaker ancestors would rise in their graves at such a discovery. They should remain quiet, however, for no Californian could live three months in London climate and become a British citizen if he knew it. One thing that reassures me that this did not happen without my knowledge is that the British refused to allow me to come into their island during the war without an American passport. Also, I feel that my accent was disinfected of any English, French, Chinese, Russian or other taints by my presence in the United States a portion of every calendar year of my life except three—even including the five in which the United States has exercised its right to draft my services, a good portion abroad.

(b) Did I ever rent a "residence" abroad? I plead guilty of this crime, but in mitigation I do appeal to the feelings of fathers who object to hotel life for babies and children.

(c) What about the political lunch where I was supposed to have entered upon a dreadful conspiracy against the weal of the American people? My real distress in this matter is not to prove an alibi, or even to complain that my name was not even mentioned, as the guests assert, but it is that I was not even invited and therefore lost an excellent lunch.

(d) I plead guilty to the criminal charge of pursuing my engineering profession in foreign parts again and again. I have a fervent hope, however, that this new doctrine of criminality will not deter our citizens from extending American professions and business anywhere in the world. They always bring something home and pay taxes on it.

(e) I gather also that it is moral turpitude on my part to have managed large enterprises. The hope to rise from the ranks of labor to the ranks of management will, however, probably not be crushed from the hearts of the American boy even by this onslaught.

Whether Mr. Hoover is ever elected President or not, the politicians will at least have become acquainted with a man who is independent, incisive and direct.

ENGINEER.

Chemistry for Undertakers

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the December, 1919, number of the *American Funeral Director* there is a contribution by Prof. C. A. Moadinger on "Chemical Conditions of the Body and Fluids" which is so full of new ideas that I could not forbear to make a transcript of some of them for the benefit of my fellow-readers. In a boxed note on the text, it is stated that the professor comes from Brooklyn, which is confirmed by the telephone directory. From the same source it appears also that he is an undertaker. In regard to the chemistry of human bodies both in life and in death he states that only lately has he been able to resume his work, that in this he has addressed himself more particularly to elementary features, and that he has "gotten" it down to a state that he believes will be understood by his audience.

"The first chemical condition of the body" that he studied was the organic salts which go to make it up, and these organic salts, he tells us, are phosphates of lime and carbonate of lime. Next to water, phosphate of lime is said to be the principal ingredient of the body, while of the carbonate there is only one-seventh as much. If we have an excess of lime in the blood, there occurs a lime deposit on the inner and middle coats of the arteries; then we have arteriosclerosis.

If into a body which contains an excess of lime, embalming fluid is injected, why is it that the fluid does not seem to be assimilated, and why does the body remain soft? The professor puts the question and answers it, as follows: "You had an excess of lime in the blood. The excess of lime, by the action of the formaldehyde that you injected, caused the carbonate of lime, which is flakes. If you take a phosphate of lime solution, or lime-water, and put a little formaldehyde into it and hold it up, you will see it flaky all through. The carbon from the formaldehyde combining with the lime forms carbonate of lime, which is flakes, and these get into the little blood-vessels and capillaries and plug them so that no fluid is allowed to pass through. That is the condition you have with excessive lime in the blood." Evidently, flakes cause undertakers as much trouble as they do steel makers!

In cases of hardened arteries the professor notes that frequently the injections of embalming fluid seem ineffective; that the injection is "hard" and the bodies are not so rigid as they might be. "This," he says, "is due to the fact that your osmotic action was lost, the lime forming a coat on the inner walls and preventing the passage of the formaldehyde and other chemicals through the blood-vessels through the tissue. You know osmosis is the passage of one liquid through a membrane into another liquid."

Other difficulties in embalming he also attributes "to the action of the formaldehyde upon the lime, which forms a carbonate of lime."

"Another chemical in the body," he says, "is known as magnesium, and is found in the muscles and the brain, but more predominant in the muscles than in the brain—here we have again by the action of formaldehyde on this magnesium a carbonate of mag-

nesium formed, which is insoluble and forms flakes." Chloride of sodium he declares to be the most important chemical found in the body, and he says it is contained in all the parts; in blood, bones, brain, hair, and in every tissue of the body. He explains its ubiquity as follows:

We must have salt, first as an alkaline in the blood to keep it in the alkaline condition; to keep it from coagulating so that it will give us a clear, perfect flow. Sometimes you crave something salty—which shows your system is in need of sodium chloride to carry on the work of lubricating the blood—sodium chloride acted upon by formaldehyde produces no other chemical. But sodium chloride aids osmosis, and if it were used more in embalming fluids, you would get better osmosis. Common salt injected into the body aids in preventing the formation of carbonate of lime from phosphate of lime.

We have a sodium potassium and potassium phosphate in the body, and these are found mostly in the kidneys—some are alkaline and some are acid. The action of formaldehyde on sodium phosphate and potassium phosphate has no bad effect outside the body.

The sodium and potassium carbonates are entirely different because they contain a certain amount of carbon which is found in the body, and the action of formaldehyde on carbonates increases rather than destroys them, and we get a higher degree of carbonization so that we have a precipitate thrown down from the sodium and potassium carbonates.

The sodium and potassium sulphates are in very small amounts in the body, and play but little part. If anything they aid considerably to cosmetic effects, and that is all.

The formation of uric acid from eating fresh beef forms in the kidneys in the form of crystals which are insoluble. These crystals break down—decompose, as it were—to form carbonate of ammonia, which forms in the kidneys and gets in the urine. This penetrates the system and gives the peculiar odor to bodies dying from Bright's disease. In these cases the action of formaldehyde is entirely lost—it is changed into an entirely different composed part; the ammonia takes up more of the carbon from the formaldehyde, changes it back into an acid similar to formic acid, and the action is lost as far as disinfectant, astringent and preserving properties are concerned.

It is rare indeed that so many novel observations in chemistry are recorded in a single paper. Prof. Moedinger contributes two new organic salts in sodium phosphate and sodium carbonate. The reaction of formaldehyde in "forming" carbonates is worthy of note. A new definition of osmosis is contributed. We learn of the "predominance" of magnesium in human muscles, of the lubrication of blood by sodium chloride, and of common salt as an "aid" to osmosis. The point as to the alternating acid and alkaline reactions of "sodium potassium and potassium phosphate" seems well taken, especially in regard to the kidneys, while an entirely unexpected function of formaldehyde in increasing "carbonization" is recommended to the attention of all persons engaged in work on synthetic resins. Entirely new is the action of sodium and potassium sulphates as aids to "cosmetic effects." It suggests additional research as to the cosmetic effect of lithium sulphate and opens up the entirely new field of *cosmesis*, whatever that may be. New to the writer also is the dissociation of uric acid to ammonium carbonate, and the third note on the behavior of formaldehyde, this time in the presence of ammonia.

Not infrequently, Mr. Editor, you have urged in your editorial columns the spread of chemical understanding among the people. I offer these selections from Prof. Moedinger's address before the Missouri Funeral Directors' Association as the very flower of popular chemistry.

MARTIN SEYT.

New York, N. Y.

American-Scandinavian Foundation Fellowships

THE traveling fellowships established by the American-Scandinavian Foundation of New York City promise to rival the Rhodes scholarship plan in interest aroused among American colleges. Twenty fellowships, each with a stipend of at least \$1,000, and in some cases \$1,200, will be awarded in May to American students, men and women, for technological research and humanistic study in the Universities of Sweden, Denmark and Norway. When it was announced a year ago that young American engineers and students of science would be given opportunity to study under such eminent scientists as Svante Arrhenius, founder of the theory of electrolytic dissociation, or Hjalmar Lundbohm, director of operations on the great iron mountains at Kiruna, officials of American technological institutions recommended for consideration the names of promising recent graduates. The men who were appointed, and who are now in Sweden, represent the best known scientific schools from Massachusetts to Wyoming. It is required that all candidates be of American birth, and all of these men had rendered scientific or military service in the army of the United States.

SCOPE OF FELLOWSHIP PLAN EXTENDED

Since that time, the scope of the fellowship plan has been greatly extended. The number of fellowships has been doubled so that five students will be sent to Denmark and five to Norway in addition to the ten to be appointed for Sweden. Not only will fellows be appointed for the study of chemistry and physics, hydro-electrical engineering, metallurgy and forestry—in all of which subjects Scandinavian countries excel—but also for agricultural sciences and for language and literature. Denmark's agricultural system and her system of folk high schools have attracted to Denmark many an educational commission from foreign countries; and English literature has drawn freely from the North from the time of the sagas of Beowulf to that of the tales of Hans Andersen. Fellows will also be appointed to Norway for the study of oceanography, the new science of the sea fathered by Fridtjof Nansen and Helland-Hansen; and for the study of weather forecasting under Prof. Bjerknes of the Bergen Geo-Physical Institute.

These twenty fellowships for American students are one-half of a group of forty exchange fellowships between America and the Scandinavian countries financed on the one side by twenty American individuals and corporations, and on the other side by twenty Scandinavians. In other words, ten students will come here from Sweden, five from Norway and five from Denmark.

HOW TO FILE APPLICATIONS

Application papers with letters of recommendation must be filed at the office of the American-Scandinavian Foundation, 25 West 45th St., New York, before April 1. The selection of fellows will be made by a jury of university professors and technical experts appointed by the Foundation.

Successful candidates will be notified about May 1 and are expected to sail from New York in early summer, so that they may have several weeks before the opening of the universities, to travel about in the countries to which they are appointed, familiarizing themselves with the language and life of the people.

Award of the Nichols Medal to Dr. Langmuir

THE Nichols Medal of the American Chemical Society was awarded for the second time to Dr. Irving Langmuir of Schenectady on Friday evening, Feb. 5, at Rumford Hall of the Chemists' Club, New York. Despite snow, sleet, rain and wind, it was a capacity audience, and its enthusiasm was as great as though some new and gifted star had arisen in the opera firmament.

Prof. Ralph H. McKee of Columbia presided, and Dr. William H. Nichols, past president of the Society, made the presentation.

Dr. Nichols gave a brief sketch of Dr. Langmuir's life and work, and with no regret that he had given up teaching and devoted himself more abundantly to research with the splendid opportunities and facilities at hand in Schenectady, he could not resist the thought what an inspiration he would have been to the coming generation of chemists if he had continued to teach. Dr. Nichols intimated that plans were in the making to improve materially the situation of professors of chemistry at universities and technical schools. Details may not be divulged as yet, but he hoped they would be in initial operation within the coming year. In awarding the medal he expressed the general approval of the recipient's fellow chemists, not only of the originality and vast scope of his work, but also of his constant disposition to accord credit to all those whose contributions had illuminated him and who had aided him in his research.

In accepting the medal Dr. Langmuir said that his curiosity in regard to the structure of atoms and molecules had begun when he was studying physical chemistry with Professor Nernst at Göttingen. Research in reaction velocities fixed in his mind the idea that there must be reasons for the phenomena exhibited, and that it was our business to find them out. Atoms and molecules had seemed real things to him rather than vague and shadowy concepts. His subsequent work confirmed this curiosity.

About a year ago he had been asked to deliver an address on adsorption at a colloquium of the staff of the research laboratory of the General Electric Co. at Schenectady. He felt that such a lecture would be but a review of the work already done and already available. On the other hand, in regard to the structure of atoms and molecules there was a field in which thought should be encouraged. The researches of physicists indicated atomic structures as built up of electrons revolving in circular or elliptical orbits around a nucleus. But if chemical reactions depend upon atoms and molecules, these must have some definite structure; they must have individuality; and there is not much individuality in concentric circular orbits all in one plane.

In a short section relating to the Cubical Atom in a paper on "The Atom and the Molecule" by Prof. G. N. Lewis of California, and published in the *Journal of the American Chemical Society* in 1916, he believed that en-

lightenment might be found. This, he said, had been his real starting point, and his work followed that of Prof. Lewis, who had, however, considered only the simpler elements. The speaker thought the theory might apply to all elements, and subsequent research has confirmed him in the belief. So leading, indeed, was this little four- or five-page note on the Cubical Atom in its suggestion that he ventured the opinion that Dr. Lewis was at least as fully entitled as himself to receive the medal. During the war, while engaged on submarine problems, he met many foreign men of science of the first rank and was surprised to observe that Lewis's contribution seemed to be wholly unknown to them.

We can, he said, count the atoms in a gram molecule more easily than we can take the census of a city. Atomic and sub-atomic magnitudes are as available to us as those of astronomy, but we are less accustomed to consider them. A few examples may help. Thus if a lump of matter the size of a baseball were magnified

to that of the earth, the atoms would be the size of a baseball. If the molecules of a cubic inch of air were changed to grains of sand small enough to pass through a 100-mesh sieve, the sand would fill a trench 3 ft. deep and a mile wide from New York to San Francisco. Recent work has shown that atoms consist primarily of a nucleus. Here all the positive charges are concentrated. The number of positive charges in the nucleus of an atom is the same as the atomic number of its element in the periodic scale. Thus hydrogen is No. 1, helium No. 2, lithium No. 3, etc., right up to uranium which is No. 92, and the nuclei of the atoms of different elements differ from one another in the number of their positive charges in this respect. Arranged around each nucleus are electrons in the same number as its positive charges. All electrons are alike.

The nucleus of an atom is very small and its diameter is not more than one hundred-thousandth of that of the atom itself. If we were to magnify an atom to the diameter of one mile, then the electrons would be about 5 ft., while the nucleus would be about the size of a walnut.

Bohr's theory of rotating electrons has found favor among physicists, but it does not satisfy the chemist. It does not explain the simplest facts. It does not explain, for instance, why lithium is not an inert gas. Lewis could not accept Bohr's theory, and he made electrons stationary, but this concept is not necessary. All that Dr. Langmuir claims is that whatever the rotation or movement of an electron in an atom may be, it is not in an orbit around the nucleus except perhaps in the cases of hydrogen and helium, but rather within a circumscribed space in relation to the nucleus. An electron in an atom has, to borrow a biological term, its restricted *habitat*, and within this habitat there is no objection to its rotation or movement. This provides three-dimensional space for the electron instead of holding it to rotate in a single plane of two dimensions. The key to the octet theory is the inert gases. These are stable, do not form molecules, and apparently have a



DR. IRVING LANGMUIR

structure in which an approximate balance of forces obtains. Low boiling points indicate this, for the obvious reason that the field of force surrounding the atoms must be very slight. If we should consider consciousness as a function of inert things, it would appear that these erstwhile pariah elements represent an ideal of matter. All chemical energy, change and reaction would appear as due to an effort to achieve their constitution. They represent a form of arrangement toward which electrons of the outer shells of other atoms seem driven to compose themselves. Abundant reasons were given to explain why, as the associations of positive and negative charges of these inert elements grow in complexity with increasing atomic weights, the number of other elements which may conform to their structure also increases. We shall give but a slight outline of some of the features presented, and refer to Dr. Langmuir's several contributions to the *Journal of the American Chemical Society*, of which the first appeared in June, 1919, and to an article on the Langmuir Postulates by Ellwood Hendrick in our issue of July 15, 1919.

OUTLINE OF THE LANGMUIR POSTULATES

The hydrogen atom has one positive charge at the nucleus and one electron. Helium has two positive charges and one electron in either hemisphere surrounding the nucleus. That of the atom of every other element has positive charges corresponding to the atomic number and, as in the helium atom, a pair of electrons, as with helium, surrounding it. Additional electrons to make up the number of the positive charges are arranged within concentric spheres outside this kernel (consisting of the nucleus and two electrons) so as to indicate a cube. In other words, if we were to divide two concentric spheres surrounding the kernel into eight parts we should find within the eight spaces between the spheres the "habitat" of each electron, and this is called its cell. It does not leave this cell unless its place is on the outside of an atom. The average position of electrons in each shell or pair of concentric spheres is at one of the eight corners of a cube. The chemical activity is chiefly on the outside of atoms, and among the inert gases all eight places in the outer shell are occupied by electrons, which explains the internal balance of forces and the chemical inertia of their atoms. No other element has this arrangement, and when the octet-forming drive of the seven outside electrons of an atom of fluorine, for instance, draws from an atom of sodium its single outside electron so that the arrangement of electrons of both is similar to that of a neon atom, then the fluorine atom becomes a fluorine ion, because it is negatively charged, while the sodium atom becomes a positively-charged sodium ion. (The atomic numbers are F, 9; Ne, 10; and Na, 11). Electrostatic force will hold the two ions together. Such combinations of ions do not form molecules, but join in a lattice, as described by Bragg. Molecules are formed as set forth in the papers referred to by the sharing between atoms of pairs of electrons in common.

The concept of the cubical atom is one of convenience rather than of precision, as is the benzene ring. Atoms of the inert gases are probably in fact approximately cubical in the arrangement of their electrons, but in a molecule consisting of atoms and ions having different concentration of charges at their nuclei, it stands to reason that the cubical forms are subject to considerable distortion.

A pleasing incident was a number of models of atoms and molecules prepared by Leffert Lefferts, which were displayed with gusto by Dr. Langmuir. That of acetic acid, which looked something like the framework of a toy airplane, was immediately recognized by the speaker for what it was designed to be, as indeed were all the other models as well.

Given adequate familiarity with the Langmuir Postulates along with the proper scholarship in science, a chemist should be able to visualize definitely the structure and form of atoms and molecules, and to consider the play of forces within and without them. He should even be able to predict within approximate limitations the physical qualities of a substance before it is synthesized. He should be able to foretell the gas, liquid or solid phase at ordinary temperatures, its electrical conductivity, crystal forms, color, etc.

When Dr. Langmuir presented his first paper on the subject at the Buffalo meeting of the American Chemical Society, Professor Washburn of Illinois offered the opinion that the occasion was momentous, and that we had listened to the greatest contribution to chemistry since John Dalton presented the atomic theory. We have not heard that he has changed his opinion.

British Production of Alcohol From Coal

The extraction of alcohol from coke-oven gas on a commercial scale was proved to be possible at a meeting of the Cleveland Institute of Engineers at Middlesbrough (England) by Ernest Bury, of Skinningrove Iron & Steel Works. Mr. Bury showed that he had succeeded in extracting ethyl alcohol and its derivatives. The practical working of Mr. Bury's process at the Skinningrove plant, where 5,800 tons of coal are carbonized per week, revealed an average yield of 1.6 gal. of alcohol per ton of coal carbonized. The ethylene in the gas is absorbed in sulphuric acid, forming ethyl sulphuric acid, which is hydrolyzed to ethyl alcohol.

The total weight of coal reduced to coke in the United Kingdom in 1918 having been 14,635,000 tons, the application of Mr. Bury's process to the entire amount of coal would yield 23,416,000 gal., the value of which would be £2,341,600 (\$11,395,000). The recovery of alcohol at the gas works of the country would yield a further 27,000,000 gal., or alcohol and benzol, taken together, would amount to 114,000,000 gal., to meet the requirements of the country, which amount to 160,000,000 gal. per annum.

Condition of the Belgian Plate and Window Glass Industry

The revival of the Belgian plate and window glass industry continues in spite of the shortage of industrial fuel and certain raw materials, notably sodium sulphate, and the transportation difficulties.

The average increase in labor costs since the armistice has been 150 per cent, taking into consideration the shortening of the hours with the general introduction of the 8-hr. day. A general increase of 10 per cent was recently granted, and operatives are now claiming further advances of from 10 to 20 per cent.

At present all of the eighteen window glass plants in operation before the war are again producing; in nearly all of them, however, only one furnace is lighted, and others cannot be started until regular fuel supplies are forthcoming.

Government Chemists' Salaries

Although chemists are classified separately, as are all of the other technical groups, they receive the same salary recommendations from the Commission on Reclassification of Government Salaries which reported to Congress on March 12. The Commission has not recommended as great increases as were recommended to it by the chemical advisers from the employees themselves, but the increases, if they are approved and accepted by Congress as the basis for action, will be sufficient to reduce materially the difficulty of holding the right sort of men.

To carry out the work started it is recommended that the Civil Service Commission be greatly strengthened and its functions enlarged to include the maintenance of continual classification work and adjustments of wages to meet changing economic conditions. Many other aspects of the working conditions, vacations, retirement, etc., are covered.

Senator Jones of New Mexico, chairman of the joint Congressional Committee on the Reclassification of Salaries, commented on the report as follows:

Generally speaking, the lower clerical services and lower grades of other services have been remunerated reasonably well. They have received, perhaps, more than is paid for similar service in private employment. In the technical branches of the service, however, the pay has been grossly inadequate. It has not been comparable at all with the salaries paid for the same service in private employment.

Our report will show that there was a crying necessity for this work. The personnel in the Government service is being employed and the work is being conducted without reference to any system. There is little to prompt efficiency and literally nothing to insure a maintenance of effort. To my mind one of the most important features of the report is that part which contemplates increased pay for increased efficiency and decrease in pay when there is decrease in efficiency. If this can be put into practice, I believe it will enable the work of the Government to be carried on more effectively with fewer employees. It will remove injustice and will increase the morale in the Government service.

Production Costs in the Dye Industry

The Tariff Commission has recently issued a pamphlet (Tariff Information Series No. 15) on costs of production in the dye industry during 1918 and 1919. The report is divided into two parts: The first contains a discussion of tables that show in detail the costs of sixteen intermediates and fifteen dyes; the second compares these domestic costs with the prices at which these products sold before the war and at which they are now selling in various markets.

In view of the unstandardized and varying methods of production and of accounting in this industry, the Tariff Commission strongly emphasizes the uncertainty of conclusions drawn from this report and the possibility of error in administrative action based upon such data. The figures are, however, the most trustworthy that can be immediately secured under present conditions in the industry, and in any discussion of the cost of production, the tables given in this report must be accepted as the nearest approach to accuracy now possible.

Tables VI and VII of the report are of particular interest in that they compare American prices on about forty dyes during the period from 1917 to February, 1920, with the German prices f.o.b. warehouse in the United States in 1914 and the reparation commission's prices with the mark valued at par. Table VI gives

prices in dollars per lb. while Table VII gives relative prices on the basis of 100 for the German prices of 1914. The accompanying table gives, by way of illustration, the figures for malachite green taken from these two tables.

COMPARATIVE PRICES OF MALACHITE GREEN

	Dollars per Lb.	Relative Prices
German prices, 1914.....	0.390	100
Tariff Commission report, 1917.....	6.280	1,610
Tariff Commission report, 1918.....	5.60	1,435
Market prices, February, 1920.....	3.50	898
Reparation commission, mark at par....	3.2414	831

A marked decrease in the prices of the American products from 1917 on will be noted in the case of nearly all of the dyes listed. It will be noted that for the most part the German prices (reparation commission) are a little higher than domestic prices and that if they were revised with the mark valued at 20c. (the German offer to Dr. Herty), the quotations in the two countries would be surprisingly close together. Furthermore, the reparation prices do not include duties, freight charges, etc., which would have to be paid before the goods could reach the ultimate consumer in the United States. This does not mean necessarily that the American producers can successfully compete in all phases of the dye industry, because in some classes of products, such as vat and alizarine dyes, which are not shown in these tables, but which are of fundamental importance to a well-rounded industry, the foreign producers still have a competitive advantage born of long practice in complicated productive processes. Other complicating factors which make it impossible to draw general conclusions from these price comparisons are conditions of the rates of international exchange.

Pennsylvania Safety Congress

The Pennsylvania Safety Congress for 1920 will be held at Harrisburg, March 21 to 25 inclusive. This Congress is a continuation of the conferences devoted to welfare and efficiency which were held prior to the war, but which have been discontinued since 1917. Arrangements for the Congress are being made by the Department of Labor and Industry, Harrisburg, which will furnish programs and other information upon request. Some topics to be discussed are the cost of industrial accidents, relations between foremen and employees, Americanization, women in industry, rehabilitation of the industrial cripple, occupational diseases and similar subjects.

Tariff Bills Before Senate

Before this issue appears in print it is probable that the Senate Finance Committee will have reported favorably all of the tariff bills which have passed the House and are now pending before the Senate committee. The dyestuffs, laboratory glassware and magnesite bills already are on the calendar and it is probable that similar action will be taken with regard to the measures prescribing duties for tungsten and zinc.

In reporting the laboratory glassware bill, which also carries laboratory porcelain ware, optical glass, scientific and surgical instruments, the committee said:

Your committee is satisfied from the showing made that we have the skill, the men, and the manufacturers who are willing and able to produce a better quality of articles than can be produced in any other country, and in quantities sufficient to supply all the demands of the United States, if they are properly protected.

Aluminum Rolling-Mill Practice—I

Commercial Pig and Scrap

The First of a Series of Articles Discussing the Details of Rolling-Mill Practice for Aluminum, Including All Phases of Work From Pig Metal to Finished Sheet—Metal for Melting Is Considered in This Installment

By ROBERT J. ANDERSON AND MARSHALL B. ANDERSON

THE practical details involved in the commercial production of aluminum sheets have not been described hitherto, so far as the writers are aware. A few papers dealing with the working and annealing of aluminum and its light alloys have appeared, to which detailed reference will be made later, but as to the rolling of substantially pure aluminum for the manufacture of sheets, very little, if anything, is on record. With the thought that a detailed discussion of the problems involved in aluminum sheet rolling may be of interest to the non-ferrous industry in general and to aluminum rolling-mill superintendents in particular, the present series of articles is offered. The scope will be mainly confined to the commercial manufacture of practically pure aluminum sheets, but a few notes on the rolling of certain light aluminum alloys will also be included.

GENERAL CONSIDERATIONS

Aluminum rolling, for the purpose of manufacturing sheet aluminum, differs from steel, brass and copper rolling in at least one marked essential, viz., the relatively low temperatures employed for hot work; further, all of the final reduction to gage is performed in the cold. Relatively low temperatures are employed for hot rolling, because of the relatively low melting point of the metal, i. e., 658.7 deg. C. In finishing to gage, depending upon conditions, the rolling may be done entirely without annealing between passes, or there may be some annealing done. At the present time, the most suitable rolling and annealing temperatures which should be employed for definite conditions are subjects of considerable conjecture. In fact, considerable doubt is entertained by the writers that many systematic scientific investigations on these matters have been made. However difficult the proof of that statement may be, the fact remains that very little information is available. A good field would appear to be open in aluminum rolling for the application of the methods of physical metallurgy; the use of the microscope in studying the changes brought about on annealing worked aluminum sheet should result in information of real value to those engaged in aluminum rolling. If duralumin is to be rolled in large quantities and to meet exacting specifications, no reasonable amount of control can confidently be expected without the metallographic microscope. The main immediate outlet for duralumin will be in the form of sheets, rods and tubes, and the structural changes resulting from working, heat treatment and aging can be interpreted most readily by microscopic methods in conjunction with physical tests.

In order to present a broad survey of commercial aluminum-rolling practice, together with the more important details involved, the discussion is divided into

two main parts, first, the production of rolling ingots, and second, the mechanical treatment of aluminum. The various processes through which the metal passes from the time pig aluminum is unloaded from cars until the finished sheets are boxed and ready for shipment will be set forth. Unless otherwise stated, the aluminum referred to in the following paragraphs is metal containing 99 per cent Al and over (based on the difference method of analysis), with copper, silicon and iron in subordinate amounts.

COMMERCIAL PIG ALUMINUM

Commercial aluminum of fairly high purity is obtainable in large quantities, and such metal containing over 99 per cent Al goes into much of the present output of aluminum sheet. About 98 to 99 per cent metal is also rolled, and considerable secondary (remelt) aluminum is used for sheet manufacture. Primary or virgin aluminum is ordinarily received by the rolling mill in the form of cast pigs of various sizes and weights. Two typical commercial pigs are those known as 33-lb.

TABLE I. VARIOUS SPECIFICATIONS FOR PIG ALUMINUM

Navy Department Specifications for Ingot Aluminum				
Chemical Properties: The chemical requirements shall be in accordance with the following table:				
Al (Min.) Per cent	Fe (Max.) Per cent	Si (Max.) Per cent	Other impurities (Max.) Per cent	Sum of Fe and Si and other im- purities. Per cent
99.40	0.60	0.60	0.10	0.60
Bureau of Aircraft Production Specification for Ingot Aluminum				
Ingot aluminum shall be ordered under three grades, conforming to the following chemical requirements:				
Grade				Al per cent (Min.)
Special				99.5
Standard No. 1				99.0
Standard No. 2				98.0
American Society for Testing Materials Tentative Specifications for Aluminum Ingots for Re-Melting and for Rolling				
Two grades of aluminum are considered under these specifications, as follows:				
A grade, containing not less than 99 per cent Al				
B grade, containing not less than 98 per cent Al				

(15-kg.) four-notch bars and 3-lb. (1.4-kg.) six-notch bars, but larger or smaller pigs may be furnished according to requirements.¹

There are two well-defined grades of primary aluminum pig, viz., grade 1 and grade 2. The former is supposed to contain over 99 per cent Al, and the latter 98 to 99 per cent Al. These grades are also referred to as grades A and B, respectively. Typical specifications for aluminum pig may be cited. Table I shows the specifications of the Navy Department and the Bureau of Aircraft Production, and the tentative specifications of the American Society for Testing Materials.

¹The nomenclature regarding forms of aluminum is rather muddled; for example, pigs are also called bars and ingots. For the sake of uniformity, metal for melting will be called pig aluminum, and metal for rolling will be termed ingot.

In connection with the extracts in Table I from the complete specifications, various instructions are given that the metal must be of uniform quality, strong, tough and sound; the specifications also state that the pig must be free from blowholes, shrinkage cracks, foreign matter and other defects. Further amplification on this subject is not considered necessary in the present article, and the writers' object in citing the above excerpts is merely for the purpose of indicating the general trend. Actually, specifications for aluminum ingot have not been entirely settled upon as yet.

The chief impurities found in the present-day commercial aluminum are copper, iron and silicon, so far as is now known, although the recent work of Rhodin² indicates that appreciable amounts of aluminum oxide (calculated as Al_2O_3) are usually found. Whether the quite large amounts found by Rhodin are normally present in average virgin pig aluminum is somewhat doubtful, but any difference method for aluminum based on determinations of copper, iron and silicon and omitting aluminum oxide is certainly liable to be in error. The presence of appreciable amounts of aluminum nitride, aluminum carbide and other aluminum compounds, as well as occluded particles of the reduction pot bath, is yet to be established, but apparently merits consideration. The supposition most generally held at the present time is that the normal and usual impurities in primary aluminum pig are copper, iron and silicon; these elements are usually determined in analyzing aluminum pig; the difference between 100 per cent and the sum of these elements is said to be aluminum. The writers are unable to accept this view of the matter and think that the difference represents aluminum plus aluminum oxide at least, and possibly some other compounds.³

As indicative of the composition of typical aluminum pig, the analyses in Table II may be consulted. With the exception of sample 10, these were all classed as

TABLE II. TYPICAL ANALYSES OF ALUMINUM PIG

Sample number	Percentages of Elements				
	Cu	Si	Mn	Fe	Al
1	0.09	0.29	nil	0.30	99.32
2	0.16	0.27	trace	0.36	99.21
3	0.12	0.34	trace	0.34	99.20
4	0.11	0.37	trace	0.32	99.20
5	0.12	0.44	trace	0.30	99.14
6	0.11	0.40	trace	0.36	99.13
7	0.18	0.40	trace	0.32	99.10
8	0.19	0.42	trace	0.31	99.08
9	0.23	0.35	nil	0.40	99.02
10	0.22	0.45	trace	0.39	98.94

grade 1. High-grade commercial metal may contain up to 99.6 per cent Al, but under the present reduction practice it is apparently not feasible to attempt any higher degree of refinement.

METHODS FOR SAMPLING ALUMINUM PIG

When shipments of aluminum pig are received at the rolling mill, samples for chemical analysis should be secured, and the shipments should be checked chemically on receipt. The car shipments are weighed and placed in a stock storage according to lot, and the metal is drawn out at future intervals for melting and casting into rolling ingots.

There are several methods in use for sampling ship-

ments of pig aluminum, and these vary in accuracy with the mode of sampling as well as with the size of the shipments. For sampling carload lots or smaller lots of pig aluminum, it is necessary to select pigs at random. For larger lots, as many samples as necessary may be selected according to the judgment of the chemist, who should supervise all sampling. In any event, it is better to secure too many pigs rather than too few.

In the fabrication of sheet aluminum, where for certain grades of sheet the specifications call for all-virgin rolling ingots, it is possible to obtain a reasonable check on car shipments by analyzing samples from various casts, say the first, middle and last casts from the melting furnace charge. Of course, this will not be possible under normal conditions when scrap aluminum is charged with the virgin pig, unless the disposition of the scrap is followed; that is a difficult matter to attempt in any plant and is hardly worth while.

For 33-lb. (15-kg.) pigs, the metal should be drilled through each notch, the separate drillings well mixed, and run over with a magnet to remove any iron contamination from the drill or drill press. Sufficient of the well-mixed drillings, about 25 to 50 g., are retained for chemical analysis. Small six-notch pigs may be drilled through each notch also, in as many places as is necessary to obtain a sufficient sample. It may be advisable in cases where more accuracy is desired to melt together in a graphite crucible sufficient pieces broken from ingots, say the end and center notches, for six-notch pig; when molten, a dip sample may be taken, poured into a chill mold, and drilled in the ordinary way at numerous points. The well-mixed drillings constitute the sample. This procedure is hardly advisable except in case of dispute. Drillings should be fine, thin chips. Coarse, uneven drillings, or those which come in long curls are undesirable, since they will be non-representative in case of segregation in the pigs. Further details will not be elaborated, since this is a matter of more particular interest to chemists than mill managers.

SCRAP, BRIQUETS AND BALES

A large amount of aluminum⁴ is turned over annually in the form of scrap, some of which goes into melting-furnace charges for ingot production and the remainder into foundry charges for alloy castings. Roughly, the scrap aluminum produced in a rolling mill with a fabricating department may be divided into three classes, as follows:

(a) Furnace scrap, including splashings from tapping and pouring, and drippings and skimmings from crucibles.

(b) Rolling-mill scrap, made up of slab and sheet shearings; buckled slabs and sheets which have caught in the mills during rolling; and defective sheets such as those which are rejected because of occluded dross, stains on annealing, and for other reasons.

(c) Fabricating scrap, resulting from sundry fabricating processes, and including shearings, clippings and punchings from punch-press operations, chips, fine and coarse "hay" from beading and trimming operations, and so on. Melting-furnace scrap and medium and heavy rolling-mill scrap is usually returned as such to the furnace; there is little opportunity for contamination by foreign materials; they are also so massive, with the exception of shearings from light-gage sheets, as to be less liable to oxidation during melting than fine scraps.

²J. G. A. Rhodin, "Contributions to the Chemistry of Aluminum and Aluminum Alloys," *Trans., Faraday Soc.*, January 1919, vol. 14, pp. 134-49.

³There is sufficient evidence to show that other oxides may be present, but that is a matter which will be dealt with in a later paper.

⁴J. P. Dunlop, "Secondary Metals in 1917," *Mineral Resources of the United States, 1917*, Part I, pp. 327-29.

For economical handling, light rolling-mill scrap and fabricating scrap should be baled, and the latter possibly briquetted, although it is often charged in its original scrap condition. There is no necessity for attempting to bale large shearings, such as from slabs, plates and heavy sheets, nor do they lend themselves readily to baling. Fine fabricating scraps and long, thin shearings, such as result from re-squaring cuts on light-gage sheets, should be baled. In the case of fine "hay," it appears that briquetting might be advantageous.

A mechanical baler can form a bale of convenient weight and dimensions for charging; such a bale may have approximate dimensions of 12 x 12 x 12 in. and weigh from 15 to 35 lb. (30 cu. cm., weighing 7 to 16 kg.), the weight of a given bale being dependent upon the amount of air space.

Briquetting has been previously discussed;⁸ it may, however, be advisable to point out under what plant conditions it may be economical to briquet as well as to distinguish more sharply between briquetting and baling. It is a well known fact that briquetting furnishes a metallurgical product from fine scrap which is practically equivalent to heavy scrap provided no contamination from foreign materials has arisen. However, whether a given plant will do briquetting or baling depends upon local conditions. Thus, if a plant operates a rolling mill for the production of sheets, there is obviously no need for the installation of a briquetting machine, unless large quantities of fine light scraps are purchased outside, since practically no small scrap results from rolling-mill operations. If most of the scrap made in the plant is medium-sized, baling will probably prove economical, provided sufficient scrap is made. Utensil-plant scrap has been successfully baled with a reduction in melting-furnace dross losses. In the event that a plant near by can do briquetting and baling, it may be advisable to send the appropriate scraps outside for treatment. Economic considerations will rule necessarily in any case. Both briquets and bales furnish good charging forms because of their convenience in handling; further, their value is increased over the value of loose scrap. Metallurgically considered, fine scraps, in the loose condition, cause high dross losses because of relative ease of oxidation, and also for the reason that these kinds of scraps are difficult of immersion beneath the surface of a molten bath. Scrap when briquetted or baled is greatly to be preferred both from the mechanical and metallurgical standpoints, but briquetting and baling can hardly be considered competitive; each has its own applications.

Part II, dealing with melting furnaces and ingot pouring, will be published in our next issue.

Movement of Tank Cars

Headquarters of the Division of Transportation of the American Petroleum Institute have been established at Room 554, 29 South La Salle St., Chicago. The organization of this department has been commenced and vigorous action is being taken toward carrying out the purposes for which it was created. Assistant directors have been appointed for field work in various territories, and everything possible will be done to accomplish results at an early date. Correspondence relative to the speeding up of the movement of tank cars should be sent to M. J. Gormley, director.

⁸A. L. Stillman, "Briquetting of Non-Ferrous Light Metal Scrap," *Trans., Am. Inst. Metals*, 1917.

Brine Corrosion of Petroleum Equipment

BY RALPH R. MATHEWS AND PHILIP A. CROSBY

PETROLEUM coming from the Healdton Field, Oklahoma, contains salt water in varying proportions, and also a small amount of sediment or silt. Most of the silt is very finely divided and when separated from the oil has a powder-like appearance. The salt water separates from the petroleum very slowly, and on standing in a tank for six months or even longer from 0.2 to 0.4 per cent is still present.

Just why the water is held in the oil so tenaciously is not exactly clear, but it appears that the finely-divided silt is in suspension in the oil and helps to support and retain the water. Due to this close association of the salt water with the petroleum, some of it travels through the pipe lines to the refineries, even though it may be in storage in the field for a considerable time. Thus the oil will probably arrive at the refinery containing 0.5 to 1.5 per cent of B. S. & W., as determined by dilution, and whirling in an electric centrifuge at approximately 1,200 r.p.m. Our experience has shown this B. S. & W. is 60 to 75 per cent salt water.

To the uninitiated it no doubt seems easy to remove the salt water by washing with good, clean, warm water, or by adding a chemical which will precipitate the objectionable salts from the water and in turn from the oil. The difficulty arises here in getting an intimate mixture between the water or aqueous solution and the tiny drops of water in the oil, which probably have a protecting oil film around them. Chemicals which break down this surface tension and would thus free the drops of water have been successfully applied to the treatment of B. S. from tank bottoms, but their application to crude oil has not given the desired results. It is probable that the large volume of oil in comparison with the small amount of water is responsible for the negative results obtained. Various methods of electrical dehydration have also been applied to recovering oil from B. S. and petroleums of high water content. The reduction, however, is generally not below 1 per cent B. S. & W., thus leaving too large amount of the objectionable salt water. The centrifuge will probably reduce the B. S. & W. to 0.3 to 0.4 per cent, but its application is expensive, and there would still be enough salt water remaining to cause the trouble indicated below.

A typical analysis of the brine shows the following figures:

	G. per liter	Grains per U. S. Gal.
SiO ₂	0.008	0.44
R ₂ O ₃	0.127	7.42
CaCO ₃	0.074	4.33
CaSO ₄	0.011	0.64
CaCl ₂	4.275	249.72
MgCl ₂	1.526	89.15
MgCl	61.140	3572.20
Total solids	67.161	3923.90

The above indicates approximately a 6.5 per cent solution of sodium chloride, and special attention is directed to the content of magnesium chloride.

OBSERVATIONS OF CORROSION

The results outlined here were obtained at a refinery where the petroleum is pumped through stills and heated to the desired temperature. The mixture

⁹B. S. & W. is an oil man's term and is interpreted as bottom settlings and water. Thus it really means the per cent of water, silt and other foreign matter in the oil.

of oil and vapors passes into an apparatus which allows the vapor to separate from the residual oil (fuel oil.) The vapor then passes through a series of dephlegmators, where it is fractionally condensed. Thus from the top of the last dephlegmator the lightest vapor passes through a condenser and the gasoline flows from there into the receiving house. Lines lead from the other dephlegmators through coolers and into the receiving house, where the necessary "cuts" are made.

The dephlegmators are arranged with water coils in the top, and after a few months service these coils began to leak. Later the tubes of the condensers started leaking water into the gasoline. Investigation showed excessive corrosion had taken place and one hole over an inch in diameter was found in a water coil when the dephlegmator top was removed.

Some of the rusty deposit found at the points of worst corrosion was removed to the laboratory and examined. It gave a slightly acid reaction and consisted largely of ferrous iron and chlorides.

ACIDITY OF OIL VAPORS

On the bottoms of the last two dephlegmators were steam lines and valves which had never been used. The lines were at the lowest points of the bottoms and any aqueous condensate would have a tendency to collect in them. There was a slight leak around the valves on these lines and a deposit showed a distinctly acid reaction and was found to consist mostly of ferrous iron and chlorides. Thus the indications pointed to corrosion by hydrochloric acid, and in order to try further to substantiate this theory a water line was tapped into the top of the next to the last dephlegmator. By means of it a small amount of water was forced down through the up-coming oil vapors. The water was trapped out in the receiving house and a sample obtained. This was examined in comparison with a sample of water taken before going through the dephlegmator and was found to have acquired an acidity equal to 8.23 grains of HCl per gal. of water.

Laboratory distillations of the oil were made, using a glass flask, and the water recovered was found to contain a small amount of hydrochloric acid. In one extreme case enough acid vapors came over during a laboratory distillation to turn blue litmus red when it was moistened and held at the mouth of the bottle containing the gasoline. The water recovered in this case was titrated, and calculation showed that the acid formation would be at the rate of 0.012 g. of HCl per liter of oil.

In view of the above evidence there seemed little doubt hydrochloric acid was responsible for the rapid corrosion, and the next step was to locate its source.

ACTION OF MAGNESIUM CHLORIDE AT HIGH TEMPERATURES

In looking for the source of the hydrochloric acid, the magnesium chloride in the salt water seemed most likely the cause. Molinari² states that "magnesium chloride volatilizes at a red heat and partially decomposes in the presence of minimal quantities of water, forming hydrochloric acid and magnesium oxychloride." This reaction starts at as low a temperature as 175 deg. C. If the reaction is carried to completion the ultimate products would be hydrochloric acid and magnesium oxide.

Stillman³ says of magnesium chloride: "The latter compound, while not scale forming, is considered an active corrosive agent upon the supposition that at the temperature of 100 deg. C. and higher it is decomposed and hydrochloric acid formed and liberated."

The oil in passing through the stills is heated to approximately 260 deg. C., and at this temperature a large amount of the magnesium chloride present in the salt water in the oil is without doubt decomposed and hydrochloric acid formed. Then the acid vapors are carried with the oil vapors into the dephlegmators.

FINAL OBSERVATIONS AND CONCLUSION

It was noted that most of the corrosion took place in the last two dephlegmators and in the condensers used with the last dephlegmator. It seems that is due to higher temperatures in the preceding dephlegmators. Thus in the next to the last dephlegmator the temperature drops to approximately 110 deg. C. and the most severe corrosion was noted on the water coils where there must have been a cooling below 100 deg. C. Some water vapor is always associated with the oil vapors, and it no doubt condenses on these water coils. The water readily collects the acid vapors and reaction starts on the metal at that point. Some of the acid vapors also carry over into the condensers, eventually causing them to give way.

We have noted this action from salt water in Healdton petroleum, but are of the opinion that petroleums from other fields could cause the same trouble, provided they carried even small amounts of salt water containing magnesium chloride.

By way of summing up, the following may be stated as covering this case in brief:

Hydrochloric acid is formed from magnesium chloride in salt water present in Healdton petroleum during distillation.

Oil vapors which contain the above acid vapor cause corrosion and produce rapid deterioration of the fractionating apparatus.

With Healdton petroleum containing 1 per cent of salt water, the amount of acid produced may be as large as 3.39 lb. of hydrochloric acid per 1,000 bbl. of oil.

Acknowledgment is made to Dr. F. W. L. Tyderman, superintendent of this refinery, for encouragement and advice in carrying out this investigation.

Roxana Petroleum Co. of Okla.,
Wood River, Ill.

New Paper Fibers

A new and very strong paper fiber has been discovered in Mexico which consists of the macerated bark of a tree called *cuazuma* or *cuahulose*. The tree is abundant in the State of Jalisco, and its bark is sometimes 20 to 30 cm. in thickness. It may be produced, it is said, at low cost.

Another promising paper material is from the leaves of a tree, *Chamserops humilis*, locally known as *doum*, which grows along the coast of Morocco in easily accessible regions. It is a dwarf palm that matures rapidly, and the annual product available is reported at about 100,000 tons. The pulp contains 75 per cent actual fibers which average 2.5 x 0.01 mm. It has satisfactory felting power, thick membrane, great tenacity, complete homogeneity, and great suppleness. The raw material may be obtained at from 3 to 5 fr. per 100 kilos.—*Le Papier*, vol. 22, p. 175 (1919.)

²General and Industrial Inorganic Chemistry, p. 527.

³Engineering Chemistry, p. 580.

A Classification of Filter Plates and Frames and Their General Usage

A Description of the Basis of Classification of Filter Plates—Flush or Recessed Types With Port or Cock Outlet Subtypes—Plain, Simple or Thorough Washing Arrangements With or Without Separate Outlets for Wash Subarrangements

By D. R. SPERRY

THERE are a great many different arrangements of filter plates and frames in use at the present day, but there has previously been no attempt to classify them scientifically. In the past the various types and arrangements have been indicated by empirical numbering or by such loose designation as "two-eyed," "three-eyed," "four-eyed," etc. The former is unscientific, because it is empirical; the latter is unscientific, because the designation is not exact, as it can be shown that the mere statement of the number of eyes which a plate has does not designate any particular type or arrangement. A two-eyed plate, for example, may be used for more than one purpose.

The object of this article is to present a classification of filter plates and frames by means of which all of the various types and arrangements which are in use at the present day can be easily enumerated. It is also desired to show in a general way what is the purpose of these various types and arrangements, so as to guide chemists, chemical engineers and others in an intelligent selection of the proper filter press for their problems. It should be understood that the classification here given does not apply to any particular make of filter press, but applies to all makes and is general.

BASIS OF THE CLASSIFICATION OF FILTER PLATES

The whole family of plates and frames used in the industries can be divided into two types—the recessed and the flush types. The recessed type plate is a plate which has a recess on each surface, usually about five-eighths of an inch deep, though in some cases thinner, while the flush plate has no recess at all, but is flush from edge to edge. Referring to the chart, Fig. 1, one will find on the left hand edge under the general heading of "Type" the words "Flush" and "Recessed." The whole family of commercial plates is included in this diagram and the plates belonging to the recessed type are all of those above the horizontal dividing line, while those belonging to the flush type are those below the horizontal line.

In practice it will be found that in addition to the two types of plates there are three different arrangements known as plain, simple washing and thorough washing. Again referring to the chart, one will find on the upper edge the word "Arrangement" and under this, the words "Plain," "Simple Washing" and "Thorough Washing." These three arrangements divide both the flush and the recessed types.

It will now be found that there are smaller subdivisions to both the "Type" and "Arrangement." Referring to the subdivisions under the "Flush" type and the "Recessed" type, these merely refer to the kind of outlet employed; that is, whether it is a cock outlet or a port outlet. This is very simple and needs no further explanation.

Referring to the subdivisions under "Arrangement," one will find under the heading of "Simple Washing" two divisions, one "Without Separate Outlet for Wash"; the other, "With Separate Outlet for Wash." The same two subdivisions will be found under "Thorough Washing." The meaning is quite clear.

It will be found that in this classification there appear certain blank spaces. These spaces, like the blank spaces appearing in the periodic classifications of the elements, may some day be filled, but at present they are not, at least as far as actual use in the industries is concerned.

It should be borne in mind that the type and arrangement of a plate has nothing whatever to do with the kind of surface on the plate nor does it have anything to do with the position in which the eyes or grommets are placed nor of the material of which the plate is constructed. The classification refers strictly to the type and arrangement and does not take into consideration such external characteristics as these things. For instance, the No. 11 plain plate, in the upper left hand corner of the diagram, would still be the No. 11 plate even if the surface was of the pyramid type and the grommet was in the center instead of in the upper left hand corner.

To recapitulate, all plates may be divided into two types, "flush," and "recess." Further, either of the two types may be divided into three general arrangements, "plain," "simple washing" or "thorough washing." This is the basis of filter-plate classification.

USAGE OF THE DIFFERENT TYPES OF PLATES

In solving a filtration problem it is always well to try tentatively the recessed type. It is always best to use the recessed type if it is applicable, because its first cost is less than the flush type due to the fact that flush type plates must invariably have frames, whereas the recessed type does not have to have frames. Suppose, for example, it is desired to clarify a certain vegetable oil. We would first investigate the possibilities of the recessed type for this purpose. We find, however, that in order to filter this particular oil it is necessary to use filter paper, and if this is carried out with the recessed type of plate, the paper will break due to the strain set up by the corners of the recess. This at once discards the possibility of using the recessed type of plate; therefore the flush type must be used, as in the flush type of plate the paper can lie flat and will not be subject to strains around the edges.

Suppose, however, that another problem occurred; namely, the filtering out of fullers earth from lard. In this case heavy canvas is used for a filtering medium and lard has no particularly deteriorating effect upon the fabric. It is therefore practical in this instance to use the recessed type of plate.

In a third case, one might have a problem in which a substance is to be filtered, the solids of which are bulky and porous; such, for example, as a mixture of mash and wort. Trying tentatively the recessed type of plate, one will find that it can not be employed in this instance due to the fact that the maximum recess which practice has shown to be possible, namely, three-quarters of an inch, will not produce a cake thick enough for this material, which will easily form a cake perhaps 3 or 4 in. thick. This at once discards the recessed type and makes the problem one involving the flush plate and frame type.

Another problem might be that of filtering a mixture of graphite water and clay such as is used in the manufacture of "lead" for lead pencils. In this particular problem it is necessary, due to the denseness of the solids, to filter a long time at a constantly rising pressure which may run to above 200 lb. per sq.in. It is desirable and indeed necessary in this case to have the cake very thin, possibly not more than three-eighths or one-half an inch. This at once throws the problem into the recessed type, as it is not practical to make a frame thin enough to produce the sized cake desired, but it is very practical to make a recessed plate with a shallow recess.

Still another problem might be the filtration of a certain aluminum salt which is strongly alkaline. Trying the recessed type for this problem, it will be found that the cloths would soon break around the edges due to the recess, as it is a fact that strong alkali has a

rotting effect upon the fibers of the cloth. This discards the possibility of using the recessed type and puts the problem into the flush type, where there is little or no sag around the edges of the filtering surface.

USAGE OF THE DIFFERENT ARRANGEMENTS OF PLATES

These five problems show in a general way how one arrives at the proper type of plate to use. After the type has been determined, it is next necessary to find out what arrangement is wanted. If the material to be filtered does not have to be washed, the arrangement is to be of the "plain" type. If, however, the material to be filtered has to be washed, then it must be either "simple washing" or "thorough washing." The physical and chemical characteristics determine which of these two types of washing should be employed. For example, if the material to be filtered is of a very dense nature, so dense in fact that a reasonable filling time builds up a cake on each chamber surface not thick enough to join the solids on the adjacent sides of the chambers, simple washing should be employed; that is to say, the wash water is introduced along the same channel that the material to be filtered entered. In this instance, if thorough washing is used, an excessive strain would be put upon the cloth on the surface corresponding to that surface of the plate against which the wash water is introduced, due to the fact that the cloth would be obliged to sag until it was supported by the solids deposited. In simple washing, however, this objection is entirely eliminated. Furthermore, the solids, through












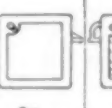

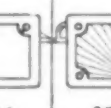
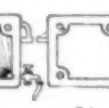
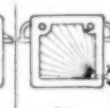
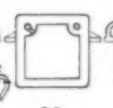
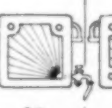
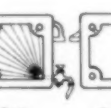
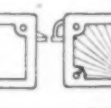


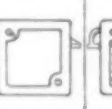
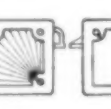
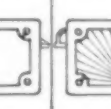
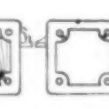
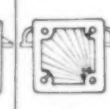
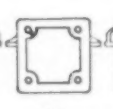
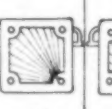
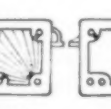
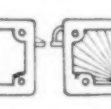


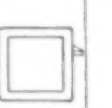

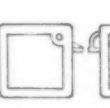
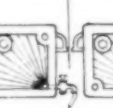

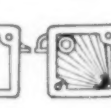


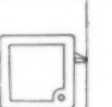

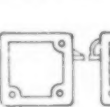
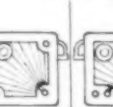

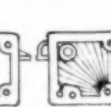

TYPE		ARRANGEMENT											
		PLAIN	SIMPLE WASHING		THOROUGH WASHING								
			WITHOUT SEPARATE OUTLET FOR WASH	WITH SEPARATE OUTLET FOR WASH	WITHOUT SEPARATE OUTLET FOR WASH		WITH SEPARATE OUTLET FOR WASH						
RECESSED	COCK OUTLET	 11			 17	 18	 110	 111					
	PORT OUTLET	 21			 27	 28	 210	 211					
FLUSH	COCK OUTLET	 31	 32	 33	 34	 35	 36	 37	 38	 39	 310	 311	 312
	PORT OUTLET	 41	 42	 43	 44	 45	 46	 47	 48	 49	 410	 411	 412
	COCK OUTLET	 51	 52					 57	 58	 59	 510	 511	 512
	PORT OUTLET	 61	 62					 67	 68	 69	 610	 611	 612

FIG. 1. CLASSIFICATION OF FILTER PLATES, TYPICAL PLATES AND FRAMES

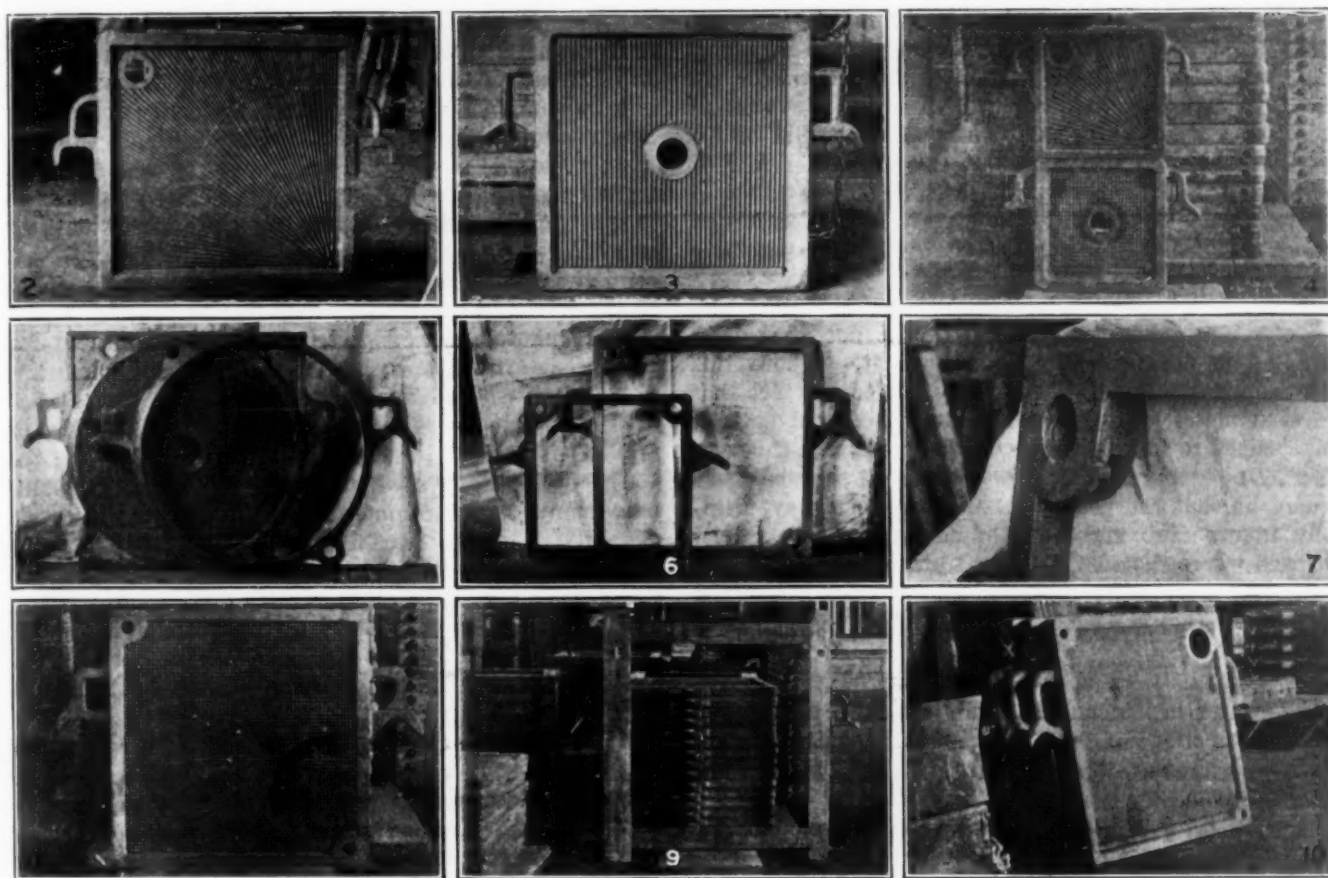


Fig. 2—No. 11 plate, radial grooved surface, corner feed. Fig. 3—No. 11 plate, parallel corrugated, center feed. Fig. 4—No. 11 plates; above, pyramid surface, center feed; below, radial grooved, corner feed. Fig. 5—No. 31 plate, No. 32 frame. Fig. 6—Small frame, No. 38; large frame, No. 32. Fig. 7—"Close-up" showing connection between eye and interior of frame. This is a feed eye; a wash eye would have no port leading to interior of frame. Fig. 8—No. 31 plate, pyramid surface. Fig. 9—No. 38, wood frame. Fig. 10—No. 11 steam-heated plate, parallel corrugated. Small eyes are for steam inlet and outlet.

which the wash water has to pass, are one-half as thick in the case of simple washing as in thorough washing, and since the solids are assumed to be very dense, this reason alone would warrant the use of simple washing.

On the other hand, suppose that the material to be filtered and washed will, in a reasonable filling time, entirely occupy the chambers of the filter press. If we were to try simple washing in this case, we could scarcely reach the solids at all but come in contact merely with those solids next to the feed port. It would therefore be necessary to use thorough washing.

USAGE OF PORT OR COCK OUTLETS, SUBTYPES OF PLATES

Treating now the sub-headings appearing under the words "Flush," "Recessed," "Simple Washing" and "Thorough Washing," the determination as to whether the outlet should be a cock outlet or a port outlet depends upon various things. If one were to filter a substance the liquid of which was highly volatile and valuable, such as alcohol or ether, it would be inadvisable to use a cock outlet, on account of the loss by evaporation. This would immediately demand a closed discharge so that the volatile filtrate could be conducted to a closed vessel without contact with the atmosphere. In the case, however, where there is no danger of loss by evaporation, the cock outlet is ordinarily used. The cock outlet or open discharge, as it is sometimes called, should always be employed if possible, because in case of breakage of a cloth the whole filtering operation will not be interrupted as in the case of closed discharge, but the operator merely turns off the cock which runs cloudy and goes on with the process.

Whether or not there should be a separate outlet for wash depends upon several conditions. Frequently it is desired to have a permanent wash outlet pipe connection which runs the wash water to some desired point. Oftentimes where thorough washing is employed, a valuable volatile substance may be the washing liquid instead of wash water. It may be some solvent, such as alcohol. In this instance, every other cock washing system would be out of the question owing to the loss by evaporation, and a separate outlet for the wash would be necessary.

The every other cock washing system, which is thorough washing without separate outlet for wash, is generally desirable, because in the case of a cloth giving out it can be at once detected by the eye or by chemical and physical tests; otherwise, it is not likely to be found out until considerable damage results.

OTHER SYSTEMS OF PLATES

The above classification, as already stated, covers those plates and frames most commonly used in practice in the United States. There are other systems which could be added, but owing to the fact that they are so rarely used, they are here omitted. One of these is the "three-plate system." We have not included this, as it is almost unknown in the industries and would therefore merely serve to complicate the classification.

There may be other eyes in a plate and yet those eyes would have nothing whatever to do with the type or arrangement. A case in point is that of the hollow or steam-heated plates in which there may be an eye for the entrance of the steam and an eye for the drip.

This would add two eyes, but would not in any way affect the type or arrangement of the plate. Again, it may be desired to have two separate outlets for the filtrate, thus adding another eye. This would not in any way affect the type or arrangement, but would be the same as though there were but one outlet for filtrate. A No. 11 plate with two outlets would still be a No. 11 plate; a No. 21 plate with two eyes in the lower corner, both of which are outlets for filtrate, would still be a No. 21 plate.

It will be found occasionally in practice that frames are used with recessed plates. This is not good practice and is not necessary in any event. Where this arrangement is found, it is usually due to the fact that recessed plates were originally purchased and later it was desired to increase the cake thickness and this was done by inserting No. 52 frames between the plates, or it may be that the press was made up that way originally in order to make use of certain stock material in cases where delivery is the paramount question, but in general there is no excuse whatsoever for a recessed plate with frames.

DESCRIPTION OF THE PLATES

The writer has included in this article a number of illustrations showing the appearance of various typical plates and frames, the number of which is in each instance given.

Figs. 2, 3, 4 and 10 all show pictures of No. 11 plates. Here we find three different plate surfaces, radial, parallel corrugated, and pyramid; furthermore, some have the feed in the upper corner, while others have the feed in the center. Yet all are No. 11 plates. Fig. 9 is discussed later.

Fig. 5 shows a round plate and frame with grommet hole and two eyes with cock discharge. One would be inclined to regard this as belonging to the 510-11-12 series, but as a matter of fact it is a No. 31 plate and No. 32 frame. The lower eye is the feed channel; the upper eye is a circulating feed return, while the central opening is for the purpose of supporting certain mechanical features. Designating this plate as two- or three-eye would be far indeed from telling to what system it belongs.

Fig. 6 shows two frames; both have two eyes, and since they both serve entirely different systems, to call them two-eyed frames would tell very little. The small frame is a No. 38 frame; one eye is for feed, while the other is for wash water. The large frame is a No. 32 frame, as both eyes are for feed. The one feed eye ordinarily used is split into two separate eyes. Examination of these two eyes would disclose a port leading into the interior of the frame in each case (Fig. 7).

Fig. 8 is a No. 31 plate. The large frame shown in Fig. 6 is used with this plate.

Fig. 9 is a No. 38 wood frame; one would imagine that it was a No. 311 frame, but it so happens that the large eye is the feed eye, while the two smaller eyes are both wash inlets. Here the ordinary one eye used for washing is divided into two eyes.

Fig. 10 is a No. 11 steam-heated or hollow plate. Seemingly this is a No. 110 or No. 111 plate, but the two small eyes are for the purpose of conducting steam to the interior of the plates and removing the drip, and have nothing to do with type or arrangement, therefore for purposes of classification are negligible.

Batavia, Ill.

Photo-electric Spectrophotometry

In connection with the color-standardization work of the Bureau of Standards, it is desired to have available a number of independent methods of making spectrophotometric determinations, especially in the visible part of the spectrum, for it is generally admitted that the fundamental basis of color specification is spectrophotometry. To supplement the color methods at present in use at the Bureau, and especially to overcome the well-known uncertainty of measurements made in the blue and violet, a method for accurate and convenient photo-electric spectrophotometry, suitable for routine determinations, has been developed, which has proven very satisfactory as to speed of operation, ease of keeping in working condition, and reliability of measurement.

The null method used has made it possible to eliminate many errors common to photo-electric deflection methods. The only variable in the process of making a determination of the transmission at any wave length is the accurately measurable distance of a small light source from the slit of the spectrometer. Measurements of spectral transmission can be made from 380 millimicrons in the extreme violet to about 650 millimicrons in the red.

Measurements of diffuse spectral reflection relative to that of magnesium carbonate have also been made. In addition, the method is applicable to the measurement of the relative radiant power of two sources and to the measurement of fluorescence, and could be extended into the ultra-violet if quartz parts were used instead of glass.

Traveling Exhibition of Canadian Goods in France

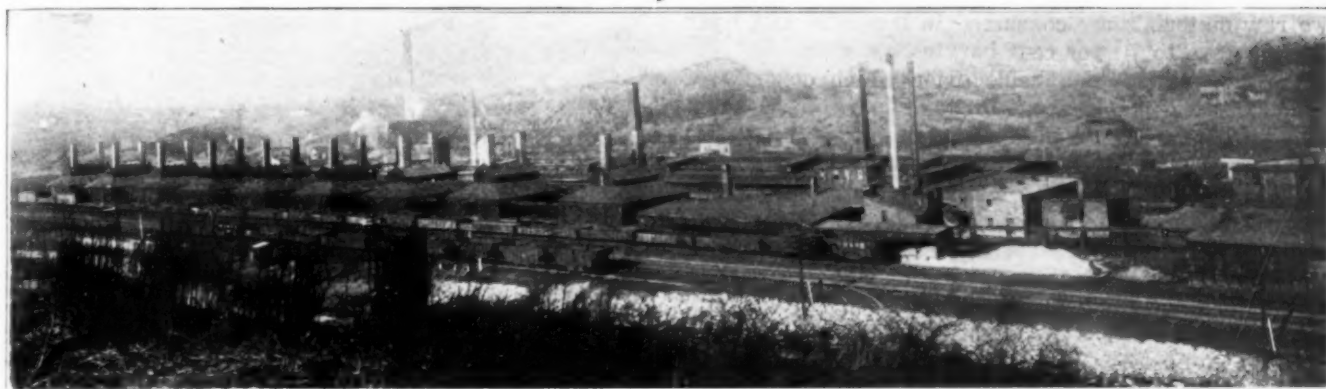
An exchange of exhibition trains for showing in one country the products of another is a recent trade-extension project that is attracting attention in Canada. The Canadian National Railways have arranged for the transportation of exhibits of French goods through Canada, and Canadian manufacturers will be able to secure a similar exhibition of their goods on a train that will be taken through the principal cities of France.

France, it is stated, is badly in need of commodities that can be supplied by Canada, especially shoes and woolen underwear. There is an immediate need of immense quantities of such goods, which the industries of France cannot produce in sufficient volume for some time. The view is taken that it is necessary only that Canadian goods should be known in order to find a larger market in France, and the plan of a traveling exhibit has everything to recommend it.

Sizes of Feet

Commerce Reports of Feb. 11, 1920, contains the following information on "Measurements Used in Exporting Swedish Lumber":

"According to Trade Commissioner Axel H. Oxholm, 69 per cent of the lumber exported by a company in northern Sweden is cut to English feet, 7 per cent to Danish feet (1 Danish foot = 0.9711 English foot), 8 per cent to "metric feet" (1 metric foot = $\frac{1}{3}$ meter = 1.0936 English feet), 7 per cent to Spanish feet (1 Spanish foot = 1.0783 English feet), 4 per cent to Dutch feet (1 Dutch foot = 1.0768 English feet), 4 per cent to German feet (1 German foot = 1.0639 English feet), and 1 per cent to decimeters (1 decimeter = $3\frac{1}{8}$ English inches)."



PRESENT PLANT OF THE COLLINSVILLE ZINC CORPORATION

Making Lithopone at Collinsville, Ill.

Historic Zinc Smelting Plant of the Collinsville Zinc Corporation Rehabilitated for the Manufacture of Lithopone—High Price of Paint Base Interested Capital in Converting Old Industry to New Manufacture in Works Long Idle—First Unit in Successful Operation

By CHESTER H. JONES

THE original plant on the property of the Collinsville Zinc Corporation was erected in 1873 by Dr. Octavius Lumagi at Collinsville, Ill., eleven miles east of the Pennsylvania R.R., for the purpose of utilizing as fuel the refuse slack from the coal mines in the immediate vicinity. One small set of Belgian block furnaces, a hand-operated blende-roasting furnace and a limekiln for burning zinc carbonate constituted the original works. In 1878 Otto F. Meister and Henry Wyman leased the Lumagi plant, purchasing five additional acres of land. New block furnaces were constructed and in 1890 the first Brown horseshoe roasting furnace in the world was erected by Herman Brown. This furnace has been put in operation with the remainder of the works under the present management.

Fig. 1 illustrates the original plant as installed and is a good example of the printer's art of that time in portraying industrial activity. It illustrates the ideas of other days in what was then regarded as

"some project," recalling much of the romance surrounding the development of the zinc industry of America.

A touch of the personal interest of the old employee in his business is also evidenced in the return of Ben Raymond, now a successful bank director in the district, who was connected with the works as superintendent during the first period of activity. Regardless of other interests, he came back on his own initiative to start the old furnaces when the new company commenced operations.

The Collinsville Zinc Corporation secures the zinc ore from its Lost Hill mines at Moselle, Mo., which have about 300,000 tons now "in sight." The lithopone manufactured at the present works, shown at the head of this article, made from a combination of this ore with barytes, is used in manufacturing paints, enamel, rubber tires, linoleum, shade cloth, wall paper, printing inks, etc. Its production is described in the following paragraphs.

PRESENT PLANT

The plant as it exists today comprises ore and coal mills, five Brown horseshoe furnaces (sixth under construction), nine Belgian block furnaces, leaching plant, lithopone driers, and finishing plant, pottery kilns, power plant and necessary shops. The leaching and lithopone drying plants with necessary conveying equipment are additions to the zinc-smelting equipment for making lithopone and the first units with a 30-45-ton capacity of lithopone per 24 hr. are in operation. When the proposed schedule is carried out a total quantity of 300 tons per day will be produced.

LITHOPHONE MANUFACTURE

The zinc ore is shipped from the company's mines and unloaded from cars to the stock piles near the mill, while the barytes comes from southeastern Missouri points less than 100 miles distant. The largest barytes deposits in the United States are in this district. These

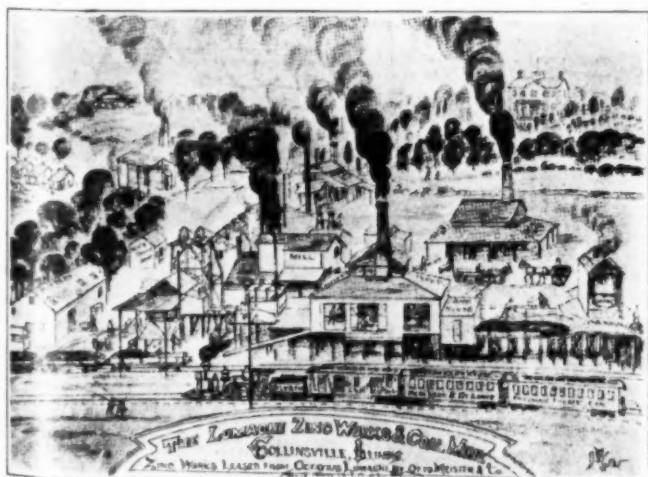


FIG. 1. THE ORIGINAL ZINC SMELTER

two raw materials are consumed in the ratio of 30 per cent zinc ore to 70 per cent barytes.

The zinc is fed to a baffle drier which consists of a short brick stack about 6 ft. square fired from beneath, the ore being intercepted by horizontal baffles in its downward course. It is received at the bottom by a jaw crusher (Blake) and subsequently enters corrugated rolls where it is reduced to pass 10-mesh screen, and is finally elevated to a storage bin.

It is removed from this storage by hand to narrow gage tramcars similar to those used in ore mines and is conveyed about 100 ft. across to the receiving hoppers which feed each pair of Brown furnaces.

ZINC ROASTING

These furnaces have a 10-ft. hearth constructed on a circle with the inner edge of the hearth built on a 70-ft. diameter. The inner wall is shown in Fig. 2. Openings for inspection and repairs are provided on both walls with buckstays between. The post in the foreground is near the center of the circle. The ore occupies a time of 20½ hr. in passing through the length



FIG. 2. INTERIOR CIRCULAR WALL OF BROWN FURNACE

of the furnace. Capacity of each furnace is about 1,000 lb. (408 kg.) per hr. of roasted ore having a sulphur content of less than 3 per cent.

Fig. 3 shows the feed end where the hopper gate is automatically tripped to deliver ore to the hearth over the chutes, as appears to the left of the wooden post. The rabblers are operated by steel cable guided in sheave pulleys. About 3 hp. is required to drive the entire rabble mechanism, which travels through the furnace at 1½ min. per revolution. The fire stack connection is located near the feed end.

Heat is supplied from three fireplaces, two located at discharge end, farthest away from stack, and one near the feed end. This is varied on some of the furnaces by having five fireplaces, three being near discharge end and two near the stack. Powdered coal is used for fuel. Firebrick is used throughout in construction of the furnace.

Fig. 4 shows the discharge end of the horseshoe with a rabble arm emerging beneath the sheet-iron door. The door is hinged to open by pressure of the carriage. When one of these rabblers comes into the open space or end of the horseshoe, between the discharge and feed ends of the hearth, it is automatically detached from the driving cable; at this moment another carriage, which has been cooling in the space, is automatically attached and is carried into the feed end of the furnace.

While the roasted ore, consisting of ZnO and $ZnSO_4$ (the latter from residual moisture), was previously removed by hand tram, on track shown in foreground,

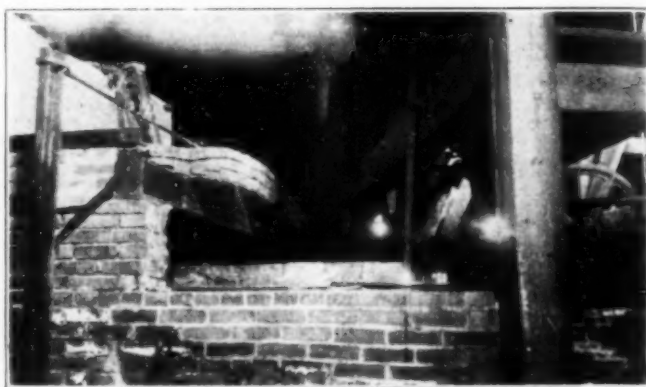


FIG. 3. FEED END BROWN FURNACE

Fig. 4, provision is being made to form a slurry with water and pump to the leaching plant, 150 ft. distant.

LEACHING THE PARTLY ROASTED ZINC

The slurry is carried over to the leaching plant, where it is distributed to each of 6 wooden tanks, 8 ft. diameter x 10 ft. high, and provided with drop bottoms for removing sludge on completion of the lixiviation. This series of tanks is arranged in a cascade at the top of which is a larger wooden tank, lead-lined, containing a 20 per cent solution of H_2SO_4 , being made by diluting chamber acid. This solution is fed to the cascade. All the tanks are heated by steam coils. The solution of zinc sulphate thus produced is pumped to six 14 ft. diameter x 10 ft. high wooden neutralizing tanks equipped with steam coils for keeping at boiling temperatures. The exact method at this point is not revealed. The neutralized zinc sulphate liquor is then ready for mixing.

BARYTES TREATMENT

The barytes is carried from the stock piles by screw conveyor to an Allis-Chalmers No. 2 Pulverator. The section of screw conveyor feeding the pulverator is steam jacketed for drying the barytes. The pulverized material is fed to the boot of a steel elevator, where 30 per cent powdered coal is added and the mixture elevated to four steel hopper-bottomed storage bins. Tramcars convey from these bins to the Belgian block furnaces. Here the barytes ($BaSO_4$) is roasted to barium sulphide (BaS), the coal in the mix acting as a reducing agent. Detail of these furnaces will be covered further on.

The BaS thus produced is known as black ash or water-soluble barium sulphide. This is mixed in a



FIG. 4. DISCHARGE END OF BROWN FURNACE

slurry and pumped back to the leaching plant, where the solid is removed in a Cyclone classifier (about 2 ft. in diameter) and the water returned to the furnaces. Only a small amount of BaS goes into solution during transportation.

LEACHING BLACK ASH

The black ash sludge drops from the Cyclone to the center of the first of three leachers arranged in series. These leachers are steel tanks about 15 ft. in diameter and 15 in. high. Each tank is divided by concentric steel walls so spaced as to form six annular channels of equal width between center and sides. Within each

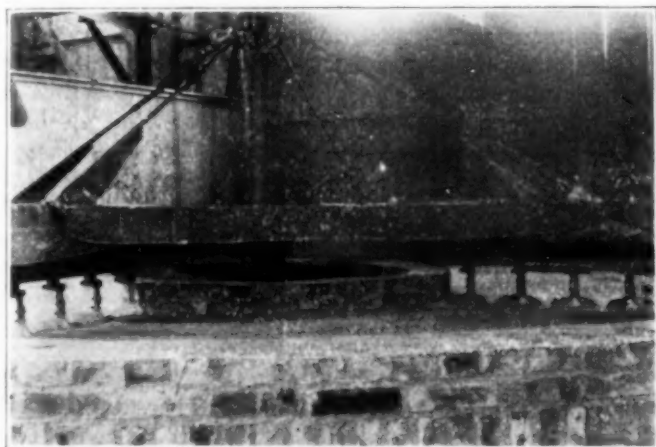


FIG. 5. FIRST DRIER UNIT

channel a shoe or paddle is suspended from the arms slowly rotating above the tank.

Clear water flows in at the center together with the black ash as referred to above and the solution flows outward over each partition, while the solid is carried along in part so that a thorough mixing results. At the final outlet of the series of tanks practically all of the BaS is carried in clear solution. The water is heated by steam during process. This is said to give more thorough leaching results than any other method so far attempted. The clear liquor is pumped to five 10 ft. diameter x 15 ft. in height steel storage tanks and the residual sludge returned to the Belgian block furnaces.

MIXING SOLUTIONS TO PRODUCE LITHOPONE LIQUOR

The clear liquors of neutral zinc sulphate and barium sulphide are pumped from their respective storage tanks to four 8 x 10 ft. wooden tanks equipped with slowly revolving agitators and mixed in the proportion of 30 per cent zinc to 70 per cent barium content. These tanks are located in the first drier building adjoining the leaching plant.

The resulting solution is pumped to the 8 x 6 ft. Oliver filter located above the drier shown in Fig. 5. The filter delivers over the splash board shown in the upper part of the picture just to the left of the center.

The driers, of which there are two complete units located in separate buildings, are each composed of a circular brick structure about 20 ft. outside diameter and 3 ft. high. A floor of brick supported by arch construction is built 6 in. from the top to form a shallow pan over which the material is moved by rabble arms equipped with shoes as shown in Figs. 7 and 8. Heat is applied by coal fire from beneath. The revolving

arms are constructed of steel I-beams and the mechanism and drive suspended from above. Hoods of sheet iron over each arm prevent the material from dropping directly on the rabble. A 10-hp. back geared motor drives the whole.

The filter is driven by a 2-hp. motor and the vacuum maintained by a 9½ x 8 in. Doak vacuum pump. A steel bin (shown in the upper right hand Fig. 5) receives the dried material from the first unit.

BELGIAN BLOCK FURNACES

After the initial drying the powdered substance is trammed to the Belgian block furnaces, where it is calcined at a temperature of about 900 deg. F. (480 deg. C.), red heat, and quenched in water while hot. Proper quenching is the key to successful operation, as the reaction must not be allowed to proceed too far.

There are nine double Belgian block furnaces, each half furnace containing 128 retorts, or 256 retorts per furnace. Each retort receives about 100 lb. of material. The two fireboxes are fired by hand with ordinary stoking coal. Fig. 6 shows a section of one face of the furnace with the refractory lids in place over each retort. The sheet iron cover on the floor is removed when discharging and the material raked from the retorts falls into the quenching pit beneath.

The retorts are supported at the ends in the walls with space around each retort to permit heat to circulate unobstructed and facilitate removal of individual retorts for repairs. Each block furnace is equipped with two stacks, and two fireboxes, one set for each face. A vertical firebrick wall separates the heat chambers.

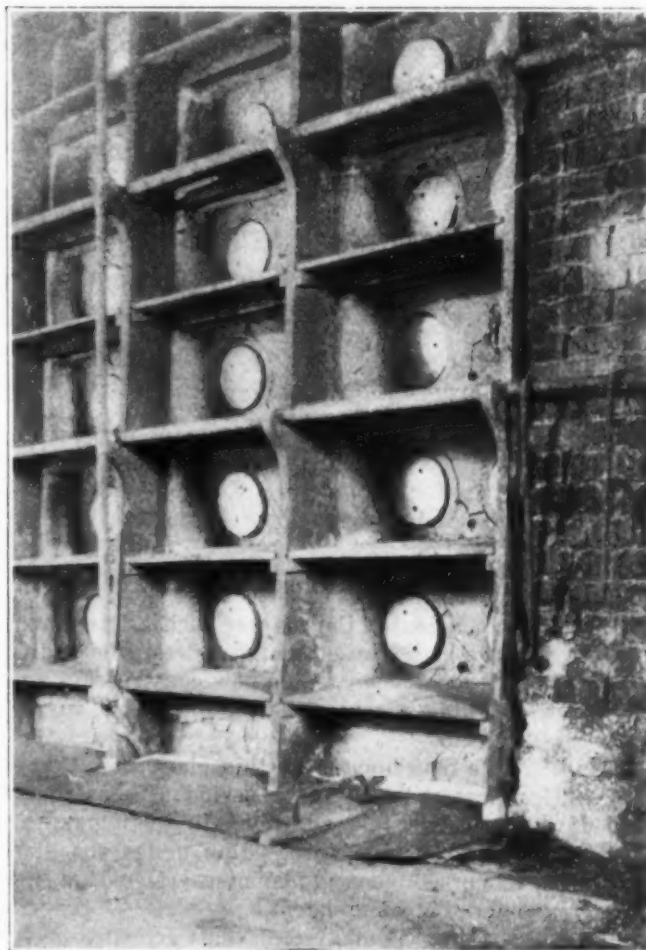


FIG. 6. SECTION OF FACE OF BELGIAN BLOCK FURNACES

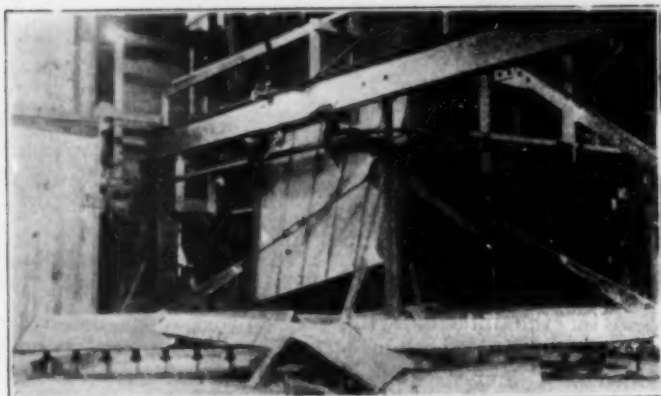


FIG. 7. SECOND DRIER IN FINISHING PLANT

The slurry formed by quenching of the calcined lithopone is pumped to the second drying unit in the finishing plant, where it is passed through an Oliver filter wheel (12 x 8 ft.), the delivery board of which is shown in the center of Fig. 7.

It will be noted that the drier is driven by chain and bevel gears. Fig. 8 shows brick construction and details of rabble plows.

After the final drying the finished material is removed from the drier bed by screw conveyor, fed to a Fuller-Lehigh mill, where it is ground to pass 300 mesh, elevated to wooden storage bins, whence it is drawn through chutes and packed in wooden barrels, lined

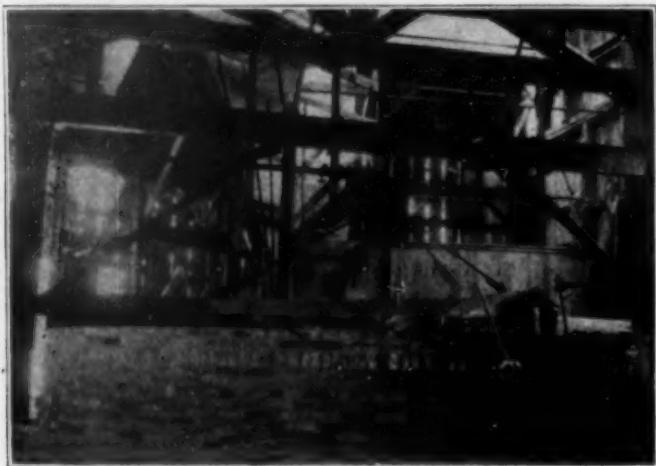


FIG. 8. LITHOPONE DRIER BED AND PLOWS

with paper bags, for the market. The commercial lithopone thus marketed analyzes about 30 per cent ZnS and 70 per cent BaSO₄.

FUTURE

With the condition of the market such as to demand this product for paint base at high prices, this adaptation of the plant is timely. The new construction work during the coming season will call for added supplies of paint pigments.

The ultimate development of this plant to full capacity of furnaces will call for a period of construction and involve considerable additions in equipment and machinery. The work is proceeding under the direction of A. F. Versen, general manager, assisted by H. E. Gillaspay, general superintendent.

We acknowledge the many courtesies extended by Mr. Versen during the preparation of this article.

Directory of Special Libraries

The Special Libraries Association is enumerating the special library collections of the country, for the purpose of preparing an adequate directory of special libraries. A work of this nature will be as useful to librarians and investigators as a directory of manufacturers is to the purchaser of machinery or supplies. It will be a census of special information sources in the United States.

A special library has been defined as:

"A good working collection of information upon either a specific subject or field of activity; it may consist of general or even limited material serving the interests of a special clientele; and preferably in charge of a specialist trained in the use and application of the particular material."

Any company having such library is requested to assist in the compilation of the directory by sending in the following information:

1. Name of institution or company.
2. Name by which library is known.
3. Name of librarian or custodian.
4. Can it be classified as any of the following: financial; business; legal; engineering or technical; institutional; municipal; reference; agricultural.
5. If not, how can it be classified?
6. Does it serve a special clientele?
7. Would your librarian be willing to assist other special libraries to a reasonable extent?

The above data should be sent to William F. Jacob, chairman Library Census Committee, care of General Electric Co., Schenectady, N. Y., who will be glad to answer any question relating thereto.

California Institute of Technology

The California Institute of Technology is the new name for the larger institution developed from the Throop College of Technology at Pasadena. It has lately received \$800,000 for general purposes and two endowments of \$200,000 each for the support of research in physics and chemistry. In addition to this, \$380,000 has been received for the construction of new buildings. An impressive architectural plan for the whole campus has been prepared by Dr. Bertram G. Goodhue, the well-known architect of New York and California.

The faculty has been strengthened in enviable measure. Dr. Arthur A. Noyes has resigned from the Massachusetts Institute of Technology and becomes director of chemical research. Dr. Robert A. Millikan of Chicago will spend one term each year and supervise research and instruction in physics. Dr. Albert A. Michelson (Nobel laureate), also of Chicago, will spend much time there engaged in research on the fundamental problem of earth tides, and Dr. Harry Bateman, formerly of Cambridge and Johns Hopkins Universities, is professor of aeronautical research and mathematical physics.

Special emphasis is placed upon the development at the Institute of the training of engineers of the creative or research type. To strengthen the courses in general culture, Alfred Noyes, the English poet, will give lectures on English literature and Paul Perigord has been appointed professor of economics.

Market for American Chemicals in Sweden

A material increase in the purchase of American drugs and chemicals in Sweden is reported by Walter H. Sholes, the American consul stationed at Gothenburg.

He reports that active introductory methods can stimulate greatly American business in that country.

Political and Commercial Control of the Nitrogen Resources of the World—II

A Description of the Commercial Aspects of Nitrogen Resources: Natural, Byproduct and Fixation Compounds, and of the Recent Developments and Changes in the Nitrogen Industry Practice*

BY CHESTER G. GILBERT†

FREE nitrogen has no economic significance. To be available in the industrial arts it must be in a state of chemical combination. The form of compound is of secondary importance, since this may be modified more or less readily to suit the need, but its value is conditioned in terms of its availability in the form of nitrogen compounds. In consequence, the several sources are classifiable industrially under three heads:

1. Natural compounds—nitrogen occurring naturally in the form of marketable compounds.
2. Byproduct compounds—nitrogen rendered available incidentally in the course of operations otherwise directed.
3. Fixation compounds—nitrogen whose availability is dependent on special fixation treatment.

Natural Compounds

Chilean nitrate is the outstanding representative of this class. The guano industry, or what there is left of it, and a few other odds and ends of production from organic sources, belong here as well, but their combined output is relatively so small that the Chilean industry comprises what amounts to a monopoly of the natural resources. It is not operated as such, however, but by private capital, which owns and operates the oficinas, paying the Chilean Government a royalty or export tax amounting to about \$11.20 per ton. British and Chilean interests share about equally in making up the far greater part of the capital invested. The balance is largely German and American. The total capitalization in 1909 amounted to approximately \$134,000,000, representing an actual valuation of about \$30,000,000. Various efforts on the part of the commercial interests involved to effect combinations for the purpose of stabilizing production have been attempted but have not been entirely successful, and the general tendency has all along been toward overproduction.

The operations, as already outlined on page 445, are crude and the cost of production is correspondingly high, amounting to around \$25 to \$30 per ton at seaboard, inclusive of the \$11 export tax. The nitrate is marketed largely through commission houses. The American situation is mostly in the hands of three companies, W. R. Grace & Co., E. I. du Pont de Nemours & Co., and Wessel, Duval & Co. The magnitude of the Chilean industry as a whole and its relative importance are shown in Table I and Figs. 2, 3 and 4.¹

¹The basis of this article by Mr. Gilbert was issued in mimeographed form for Government use as one of the Political and Commercial Geology Series prepared under the direction of J. E. Spurr, to whom book rights are reserved.

*For Part I see CHEM. & MET. ENG., vol. 22, No. 10, March 10, 1920, p. 443.

†Curator of Mineral Technology, U. S. National Museum.

²See CHEM. & MET. ENG., vol. 22, No. 10, 1920, pp. 444, 445, 446, 447.

Byproduct Compounds

To this class of compounds belong, with the few minor exceptions already noted, the nitrogenous products of organic derivation as a whole, and those from carboniferous sources, such as coal and oil shale. From the former source comes a miscellany of organic refuse resulting from activities dealing with animal, vegetable and fish products, and carrying nitrogen in the form of organic ammoniates commonly left as such for use in agriculture. From the latter the nitrogen recovered is all chemical nitrogen in the form of ammonia or ammonium salts, mostly ammonium sulphate.

ORGANIC NITROGEN SUPPLY

The organic production is impossible of definite analysis from any angle. The lack of systematically compiled records and back of that the miscellaneous largely decentralized character of the output, along with the fact that the producing costs are for the most part indistinguishable, leaves altogether too much to the imagination. Much of the supply is derived from connections of sanitation, especially of local sanitation, such as the rural practice, for which there is no measure whatever. Another prominent source of supply is represented in what is known as tankage, the refuse from animal-rendering plants; but here too the issue is lost in the scattering of the production, the indefiniteness of composition, and the fact that not all of the product is used as a source of nitrogen, some of it going into the preparation of animal food. The same is true of cottonseed meal and various other less prominent forms of organic waste resulting from industrial activities. Fish scrap and slaughter-house refuse from meat packing also contribute prominently and at the same time rather more definitely to the supply of agricultural nitrogen; but even here adequate figures are not available. The Federal Trade Commission undertook to analyze the 1913 consumption, with results given in Table II.

TABLE II—ESTIMATED CONSUMPTION OF NITROGEN IN COMMERCIAL FERTILIZERS FOR 1913

Materials	Fertilizing Substance	Tons Consumed	Content (per cent)	Units Consumed†
Nitrate of soda.....	Ammonia	260,000	18.0	4,680,000
Sulphate of ammonia.....	Ammonia	130,000	25.0	3,250,000
Cyanamide.....	Ammonia	15,488	18.0	278,784
High-grade tankage.....	Ammonia	210,000	10.5	2,205,000
Concentrated.....	Ammonia	18,351	14.5	266,090
Dried blood.....	Ammonia	40,000	17.0	680,000
Dried fish scrap.....	Ammonia	50,000	11.0	550,000
Cottonseed meal.....	Ammonia	660,000	7.5	4,950,000
Total.....				16,859,874

†A unit is 1 per cent of a ton, or 20 pounds.

This estimate, however, takes into account only the more strictly industrial sources, leaving rural sanitation and the like out of the reckoning.

Aside from the conversion of organic ammoniates, which is practiced on a large scale only in a few instances, notably that of the Paris system of sewage disposal, four general types of industrial operation figure more or less in the production of byproduct ammonia. They include coal distillation, bone carbonization, oil-shale distillation and blast-furnace operations. The American production, however, is all derived from the first two types. Both the others are active producers abroad, especially in Scotland, but neither of them has as yet obtained a foothold in this country. The American recovery in connection with bone carbonization is of minor consequence. Practically the whole supply comes from the gas works and byproduct coking operations. Fig. 3, in the shaded area designated "ammonium sulphate production," shows the magnitude and trend of the production from year to year since 1900.

MAGNITUDE OF BYPRODUCT NITROGEN COMPOUNDS

The organic nitrogen recovered in all of the various byproduct connections taken together probably constitutes 40 to 50 per cent of the total supply. Coal product ammonia in this country adds another 12 to 15 per cent. So over half of our supply is of byproduct derivation. The domestic output is supplemented in the case of the organic form by considerable importations from South America, and as shown in Table I, until interfered with by the war, small amounts of ammonium sulphate were imported annually from Europe. Essentially, however, the byproduct supply is of domestic origin. Despite its magnitude, it occupies an anomalous sort of position industrially. It is recovered incidentally for what it is worth, and sold for what it will bring. The cost of production is largely charged off against the major operations with which its recovery is associated, and the returns are credited in conformance as a saving in the cost of the major operations. This is equally true whether the source be that of the domestic animal on the farm, a coke oven, or a packing house.

CONTROLLING FACTORS IN THE BYPRODUCTS NITROGEN SUPPLY

The industrial output is built up as a sequence to industrial concentration. This is evidenced all down the line, notably in the output of coke-oven ammonia from the steel industry and in that of organic ammoniates from the meat-packing industry. It is this influence of co-ordinated industrial concentration, along with the call for the major operations, that controls the supply of byproduct nitrogen; so the development and handling of the industrial output comes naturally to be largely in the hands of trade combinations. Thus, the coal product ammonia situation is largely at the disposal of The Barrett Co., the tankage and other animal product ammoniates gather for disposal at the hands of the packing interests, and the nitrogenous fertilizers from cottonseed are for the most part prepared and marketed by interests subsidiary to the Cotton Oil Co.

BYPRODUCT SUPPLY IS NOT A DETERMINING FACTOR IN THE PRICE OF NITROGEN

The manufacturing interests involved are concerned primarily in the manufacture of other than nitrogen products. The byproduct nitrogen recovered has to compete for its market against what comes from the two other industrial classes of supply, and its price goes just low enough to enable it to do so. The limits set in the

incidental character of the output leave no special incentive to carry the price competition further. Whatever additional latitude of advantage as to cost of production it possesses goes not to promoting a further reduction in the price of nitrogen but to lowering costs with reference to the major theme of production. Gas-house ammonia, for instance, does not affect the nitrogen market so much as it does the cost of gas, and the organic ammoniates recovered in connection with meat packing have not lowered fertilizer costs so much as they have kept down the cost of meat to the consumer. Thus, the byproduct class of supply, though the leading one in the point of magnitude and by far the cheapest to produce, has little to do with determining the price of nitrogen. The selling price of byproduct nitrogen is determined by the price the product from competing sources brings. In this country it is controlled by the price of Chilean nitrate, and not, as commonly imputed, by the trade combinations that develop and handle it.

Fixation Compounds

Nitrogen has five general habits of combination—that with oxygen, giving rise to nitric acid and its retinue of nitrate salts; that with hydrogen, giving ammonia and the ammonium salts; that with carbon, to form cyanogen and the cyanides; that with basic elements, yielding nitrides; and organically, in the form of organic ammoniates. Various projects have been advanced for turning these to account in the fixation of atmospheric nitrogen. For the most part they have met with little or no practical success, but there are exceptions to the rule of failure in all five directions.

DIRECT OXIDATION—ARC FIXATION

Nitrogen does not oxidize at all readily under any ordinary conditions, but its natural indisposition to combine with oxygen may be overcome by passing a mixture of the two gases through an electric arc. The atmosphere furnishes the nitrogen and oxygen ready mixed, so all that is needed in the way of raw materials is an abundant power supply. Arc fixation was developed in Norway, where the possibilities in the way of hydro-electric power give the best setting to be found anywhere in the world. Efforts to introduce it elsewhere have resulted unsatisfactorily, and arc fixation has made relatively little headway, as may be deduced from Table I and Figs. 2, 3 and 4. The reason is twofold. So far, its use of power has proved uneconomical and its product unsatisfactory. The former of these two objections depends for its force on the demand for power, but the latter is more decisive. The immediate end-product is nitric acid, which is both difficult to transport and limited as to use. To be put in shape for agricultural use it must be neutralized in the form of a nitrate salt. Limestone is the only cheap neutralizing agent. This gives a salt, calcium nitrate, which absorbs moisture, cakes, and is thus unsuited to the American agricultural practice of machine drilling. An experimental plant near Seattle, Wash., aims to overcome this difficulty by turning out its arc product in the form of sodium nitrite, but the project is of no commercial significance as it stands at the present time.

AMMONIA FIXATION

Nitrogen is no more disposed to combine of its own accord with hydrogen to give ammonia than with oxygen to give nitric acid. In the case of the Haber process, the only synthetic ammonia process that has stood

the test of industrial application, the native indisposition to combine is overcome by subjecting a properly proportioned mixture of the two gases to heat and pressure in the presence of a catalyzer. This process was instituted in Germany shortly before the outbreak of the war, and as shown in Table I and Figs. 2, 3 and 4, has developed steadily since then. Little seems to be known as to the efficiency of the German Haber practice. Apparently careful manipulation is necessary to obtain results. This means skilled attention, which is incompatible with mechanical volume production and is thus unsuited to American practice. What aims to be an adaptation to American conditions was worked out by the General Chemical Co., and a plant with a rated capacity of 60,000 lb. of anhydrous ammonia per day was projected at Sheffield, Ala., at the instance of the Government. The plant was completed, but before it could be tuned up for actual production the war ended.

CYANIDE FIXATION

Nitrogen in passing through a red hot mixture of finely divided soda ash, coke and iron reacts with the sodium and carbon to give sodium cyanide. This principle of fixation is being extensively experimented with but has not been developed commercially, except in a small plant with a rated daily capacity of ten tons of sodium cyanide at Saltville, Va.

CYANAMIDE FIXATION

Hot calcium carbide will absorb nitrogen, forming a compound of calcium, carbon and nitrogen, according to the formula CaCN_2 , known as cyanamide. The cyanamide process, based on this reaction, has been extensively developed, far more so than any other of the various processes, as will be seen by referring to Table I and Fig. 2. Offhand, it looks to be the most adaptable and consequently the most promising of the lot commercially. In this connection, however, it is interesting to examine the several charts of its growth in the warring countries given in Fig. 2. In none of these is the showing indicative of a strong, healthy development. Worst of all is the case of Germany, with the contrast offered in the Haber and cyanamide charts. Until the war, cyanamide manufacture was unable to obtain a competitive foothold in the United States, although a small plant has been in operation at Niagara Falls in Canada for some years. The problem it has faced is similar to that already chronicled for arc fixation, in that it draws heavily on power in the preparation of the necessary carbide, and the cost of power in this country has been prohibitive. Under the stress of the war-time demand for nitrogen, however, the Government contracted for the erection of three plants—one at Muscle Shoals, Ala., one near Toledo, Ohio, and one near Cincinnati, Ohio—with a total rated capacity amounting to 220,000 tons of ammonium nitrate per year. The work on all three was well under way but none of the plants had reached the producing stage when the signing of the armistice brought the nitrate activities of the War Department to an end.

NITRIDE FIXATION

The only process of any prominence aiming to fix nitrogen in the nitride form is one developed by the Aluminum Co. of America. This has for its working principle the fact that a mixture of alumina and carbon highly heated will absorb nitrogen by reacting to give aluminum nitride. The nitride when heated with caus-

tic soda gives its end product in the form of pure ammonia. The outstanding difficulty encountered in applying this process commercially seems to be that of providing a furnace capable of standing the temperature requirements. At all events the process has not succeeded in making good industrially.

BACTERIAL FIXATION

The artificial attempts at fixation have been directed almost wholly toward employing chemical principles. In view of the difficulties experienced and the uncertain value of the results as a whole, it is interesting and perhaps highly significant to reflect that after all, as indicated in Fig. 1, inorganic chemical principles seemingly have little to do with developing the natural supply, probably because of the activities of nitrifying bacteria. Little attention has been given to the possibilities in this direction. This is only natural so far as commercially actuated research is concerned, since it does not lead in the definite direction of patent rights; but the failure to institute an adequate investigation governmentally can be attributed only to lack of comprehension with reference to the scope of the nitrogen issue as brought out on pages 446 and 447. The subject has received just enough attention to show that bacterial fixation represents a tremendous field of grossly neglected possibilities.

Recent Developments and Changes in Practice

The whole matter of fixation must be regarded as in process of development. True, it was instituted about fifteen or twenty years ago and has grown to represent the largest producing source of chemical nitrogen with operations in practically all the important industrial countries in the world and with responsible financial backing. But no one can examine the charts in Fig. 2 without recognizing the premature mushroom quality of the upgrowth, induced primarily in response to the political conditions leading to and through the war. This is especially true for the American situation. When the war broke out, fixation here was confessedly still in the dependent stage of its development, unable in every effort it had made to stand alone industrially. In the main, the developments that have transpired subsequently have followed along pre-existing lines. In so far as they have done so, little actual economic significance is to be attached to them. For the rest, the new developments, all that can be said at this juncture is that they are disappointingly meager.

MILITARY AND AGRICULTURAL NITROGEN FIXATION PROCEDURE

Just one war-time achievement, the oxidation of ammonia, stands out as affording a worth that is unmistakably clear. The nitrogen situation, it will be recalled, has two aspects, the military and the agricultural. The military focus is on nitric acid and the readiest means of insuring a supply; the agricultural focus is on ammonium compounds or their equivalent in neutral nitrogen salts and the most economical means of supply. Here, then, is a parting of the ways to expediency, and it is at this juncture that with military influences to the fore the nitrogen developments of the past few years were led off on an uneconomical tangent of military control. The Bureau of Mines, however, taking up the work of others, has perfected a simple, effective means for oxidizing ammonia to nitric acid. This, beyond question, is the most important contribution of the day.

Its significance may perhaps best be brought out graphically as in the accompanying Fig. 5.

ADVANTAGES OF AGRICULTURAL NITROGEN FIXATION PROCEDURE

Ammonia oxidation, it will be observed from Fig. 5, gives a means of supplying the military requirement from the direct line of agricultural efficiency. From the strictly military viewpoint, it has the objection of being a roundabout procedure. The dotted line of direct military procedure, however, has no peace-time function, and consequently cannot be maintained in time of peace in

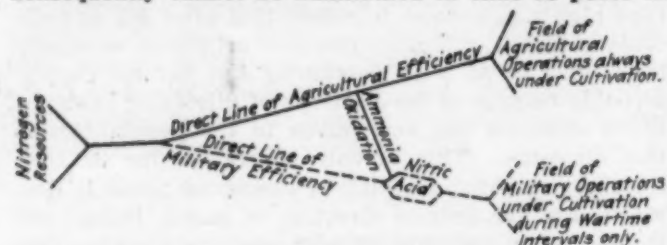


FIG. 5. MILITARY AND AGRICULTURAL NITROGEN
FIXATION PROCEDURE

trim for war, but must instead be built up expressly to meet war-time exigencies. We have had an illustration of what this means in the way of time and money, and this one ought to suffice. The agricultural channel once built up on a basis of economic efficiency is open at all times. At the most, all that is required is to keep an eye to the emergency needs in the way of oxidation equipment, a relatively simple matter. Thus, instead of the precarious procedure of trusting to luck which characterized our pre-war attitude toward nitrogen on the one hand or of attempting the impossible in the way of maintaining a military program of industrial procedure in time of peace on the other, all that is needed is a constructive program devoted expressly to the interests of economic efficiency.

(Part III, dealing with the nitrogen outlook and a bibliography on the general subjects of the nitrogen industry, will be published in our next issue.)

Mineral Oil as a Factor in United States Trade

MINERAL oil has been a factor in the foreign commerce of the United States since 1862, when the first statistical record of imports and exports of this commodity appears. So rapid has been the growth of this trade that in the fiscal year ended June 30, 1919, mineral oil ranked first in order in magnitude of quantity in imports and second in exports. Its comparatively low value, however, places it fifth in value of exports and far down the list in value of imports. In 1862 exports of mineral oil, both crude and refined, were 5,829,929 gal., valued at \$1,539,027. Fifty-five years later, in 1917, these exports reached the peak, aggregating 2,748,328,485 gal., valued at \$230,968,940, but fell in 1919 to 2,529,064,893 gal., valued at \$344,233,216, a decrease of 8 per cent in the quantity but an increase of 49 per cent in the value.

Despite the fact that the United States is the world's largest producer and exporter of mineral oils, imports have grown from a total of only 211 gal., valued at \$141, in 1862 to the enormous amount of 1,978,951,092 gal., valued at \$28,612,799, in 1919. When compared

with 1914, the last pre-war year, this is an increase of 150.1 per cent in the quantity and of 109.4 per cent in the value.

The oil industry was begun in America in 1859, in which year the production of crude petroleum in the United States was estimated at 2,000 bbl. So rapidly did the industry grow that in 1860 production rose to 500,000 bbl., and it has climbed steadily since to the high record of 350,131,000 bbl. for the calendar year 1918. The output of the United States from 1859 to 1918, inclusive, makes a grand total of 4,602,775,000 bbl. of 42 gal.

A total production of 350,131,000 bbl., valued at \$690,190,000, in 1918 places petroleum third in the value of mineral products of the United States. Bituminous coal led, with a production valued at \$1,465,000,000, and pig iron was next, valued at \$1,180,759,565.

Despite the fact that the production of mineral oil has increased from a little less than 266,000,000 bbl. in 1914 to more than 350,000,000 bbl. in 1918 (production figures are for calendar years), imports of mineral oils have increased steadily, reaching a total of 1,978,951,092 gal., valued at \$28,612,799, in the fiscal year ended June 30, 1919, against 791,187,399 gal., valued at \$13,665,940, in 1914 and 1,403,727,624 gal., valued at \$21,926,370, in 1918. This is an increase of 575,000,000 gal. in 1919 over 1918. These imports are mostly crude oil and come chiefly from Mexico, with comparatively small quantities from Peru and Trinidad, all of which arrives by tank steamers. With the single exception of 45 gal. in 1916, no oil from Mexico was entered across the Mexican border during the past six years.

EXPORTS AND PRICES OF MINERAL OILS

Although imports are mostly crude oil, more than 90 per cent of the exports of mineral oil goes out in the refined form. There has been a gradual decline in the quantity since 1917, despite which the value, reflecting the advance in price, registered an increase of more than \$113,000,000 in 1919 over 1917, and the total valuation of \$344,233,216 breaks all previous records. When compared with 1914 figures, exports of mineral oils show an increase of only 10.8 per cent in the quantity but an increase of 126.2 per cent in the value.

Exports of mineral oils in the fiscal year ended June 30, 1919, comprised 163,782,498 gal. of crude mineral oil, valued at \$9,905,490; 898,044,039 gal. of fuel and gas oil, \$49,918,288; 725,686,746 gal. of illuminating oil, \$81,495,706; 273,148,541 gal. of lubricating oil, valued at \$86,156,695, including 7,596,525 gal. of paraffine oil, valued at \$1,173,821; 322,920,087 gal. of gasoline, \$78,088,061; 145,301,861 gal. of all naphthas and other light products of distillation, \$38,654,419; and 181,121 gal. of residuum, \$14,557; making a grand total of 2,529,064,893 gal., valued at \$344,233,216.

The average import price of crude mineral oil was 1.5c. per gal. in 1914, but fell to 1.25c. in 1919. The average export prices per gal. of the various mineral oils were as follows: Mineral oil, crude, 4.7c. in 1914 and 6c. in 1919; fuel and gas oil, 2.9c. in 1914 and 5.6c. in 1919; illuminating oil, 6.4c. in 1914 and 11.2c. in 1919; lubricating oil, 14.1c. in 1914 and 31.5c. in 1919; gasoline, 14.3c. in 1914 and 24.2c. in 1919; all other naphthas, an average of 13.8c. in 1914 and 26.6c. in 1919. All export prices show substantial increases, but the price of lubricating oil shows the heaviest advance, having more than doubled since 1914.

The Nature of the Defects Revealed by the Deep Etching of Transversely Fissured Rails*

Microscopic Studies Which Show That the "Gashes" Developed by Deep Etching of Polished Surfaces Correspond to Tightly Closed Intracrystalline Cracks — They May Be Discovered by Dipping a Magnetized Specimen Into a Suspension of Fine Iron Dust

By HENRY S. RAWDON†

THE importance of deep etching by means of concentrated acid in the study of rails showing the defects of transverse fissures has been definitely established.^{1, 2} The real nature of the defects revealed has never been demonstrated with certainty, however, and in consequence various views are held as to the interpretation and value of the indications of the deep-etching test. In the different conflicting opinions expressed, the "defects" revealed in rails of this type have been attributed to possible variations in the rate of solubility of the steel in different directions, to internal stresses within the material, and to pre-existing discontinuities or separations within the metal. All of the previous investigators of this subject agree, however, that the defects are of such a nature that ordinary metallographic methods do not reveal their presence. As part of the study of railway materials authorized by

As material for study, three rails which had been removed from the track because of the presence of transverse fissures were used. The three differed markedly in composition, as shown by the data summarized in Table I:

Rail No.	Carbon, per Cent	Manganese, per Cent	Phosphorus, per Cent	Sulphur, per Cent	Silicon, per Cent	Chromium, per Cent	Nickel, per Cent
1	0.63	0.71	0.014	0.022	0.09	0.50	1.89
2	0.62	0.91	0.020	0.036	0.01	Not detected	Not detected
3	0.90	1.22	0.094	0.022	0.14	Not detected	Not detected

Sections of the head of each of the three rails were cut parallel to the tread into a series of slices approximately $\frac{1}{4}$ in. in thickness. Each of these slices, after

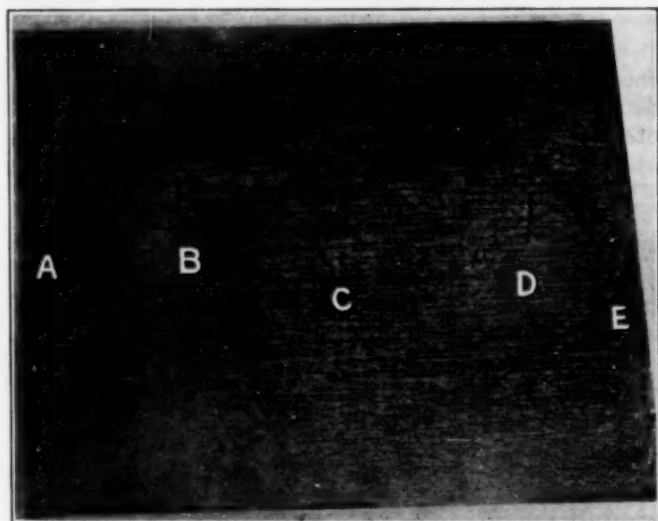


FIG. 1. DEFECTS REVEALED IN TRANSVERSELY FISSURED RAILS BY DEEP ETCHING

Longitudinal section of rail No. 3 (Table I) parallel to the tread. The surface was deeply etched with hot concentrated hydrochloric acid. $\times 1$.

Congress by special appropriation for the purpose, the Bureau of Standards has been engaged for some years in the investigation of defective rails, particular attention being paid to those showing transverse fissures. The urgent need of determining the nature of the defects in rails of this type which are revealed by deep etching has recently directed the course this investigation has followed.

*Report No. 85 to Rail Committee, Am. Ry. Engrg. Assn.

†Associate Physicist, Bureau of Standards.

¹F. M. Waring and K. E. Hofmann, "Deep Etching of Rails and Forgings," A. S. T. M. *Proceedings*, vol. 19, (1919), and discussion of same. Also *Iron Age*, vol. 104, pp. 13-16 (July 3, 1919).

²M. H. Wickhorst, "Transverse Fissure Rails on Atchison, Topeka & Santa Fe Railroad, Heat 41,177," Bulletin 218, Am. Ry. Engrg. Assn. August, 1919, p. 1.

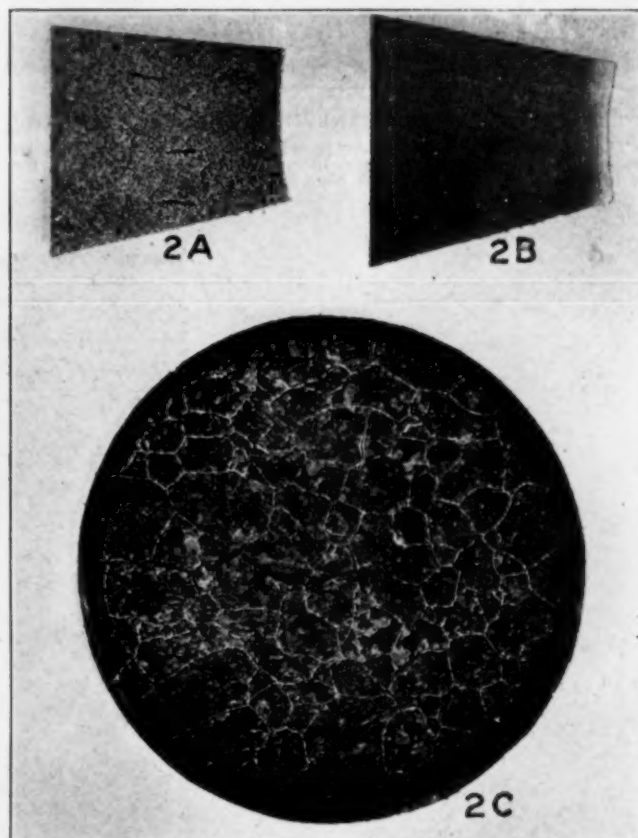


FIG. 2. DEFECTS IN GUN FORGINGS REVEALED BY DEEP ETCHING

A. Transverse radial section from a forging for a gun tube deeply etched with concentrated hydrochloric acid. $\times 1$.

B. Same specimen as "A" after polishing, but before etching. The defects revealed in "A" are readily visible before the specimen is etched. $\times 1$.

C. Cross-section of a 1-in. "round" trepanned out of a large bloom intended for a gun tube; etched with 2 per cent alcoholic nitric acid. The crack, which is, undoubtedly, of the same origin as the defects in "A" and "B," probably originated at a rather high temperature. It is largely intercrystalline in its course. $\times 3$.

grinding, was etched with hot hydrochloric acid (sp.gr. 1.19), to determine whether the defects noted by previous investigators were present or not. In each rail they were found in abundance in the central and the lower portions of the head. Fig. 1 shows a longitudinal section, parallel to the tread, cut from the lower portion of the head of rail No. 3 which has been deeply etched.

Defects similar in appearance to those seen in the etched rail sections have been noted in defective ingots and blooms of gun steel. Fig. 2a shows the defects in such material. That these defects are initially present in the material is evident from Fig. 2b, which shows the same material before etching. The nature of these

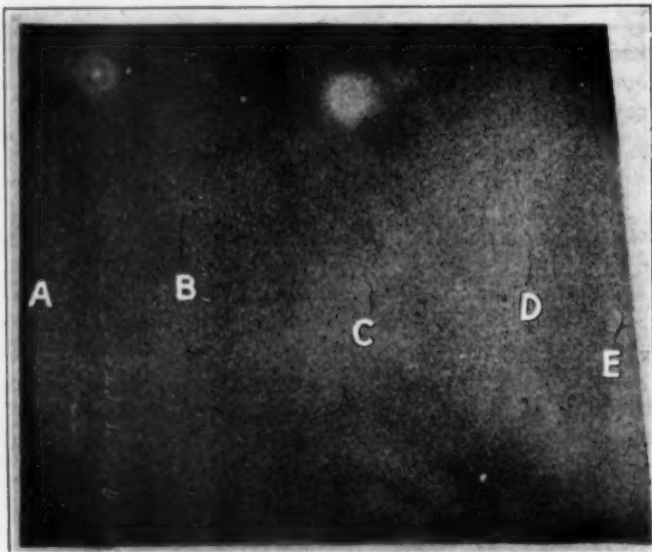


FIG. 3. DEFECTS IN TRANSVERSELY FISSURED RAILS

The specimen of Fig. 1 after polishing, but before etching, was magnetized and then immersed in a suspension of fine iron dust in kerosene. (Compare with Fig. 1.) $\times 1$.

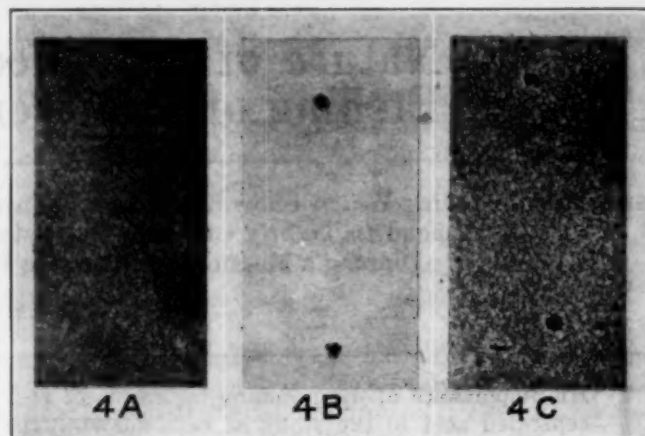


FIG. 4. INTERIOR CRACKS EXISTING IN TRANSVERSELY FISSURED RAILS

A. Crack "B" of Fig. 3 viewed obliquely. $\times 3$.
B. Same specimen as "A"; the line of the crack shown in "A" was located by a punch mark at each end of the crack and the iron dust was wiped off. No crack is visible. $\times 3$.
C. Same specimen as "B" treated a second time with iron dust. (Compare with "A.") $\times 3$.

"cracks" or separations is illustrated by Fig. 2c, which shows a section of a 1-in. "round" trepanned out of a defective bloom of gun steel. The defects are of the nature of cracks largely intercrystalline in their course—i.e., they extend between the grains, for the most part, rather than across them.

It might naturally be expected that the defects revealed in the rails are of the same character as those shown above in the gun steel. It is extremely difficult, however, to demonstrate the presence of any features in the unetched material corresponding to those found in the deeply etched specimen. As already stated, the usual metallographic methods are ineffective; various other means were tried, including examination by means of X-rays. Radiographic examination even of sections

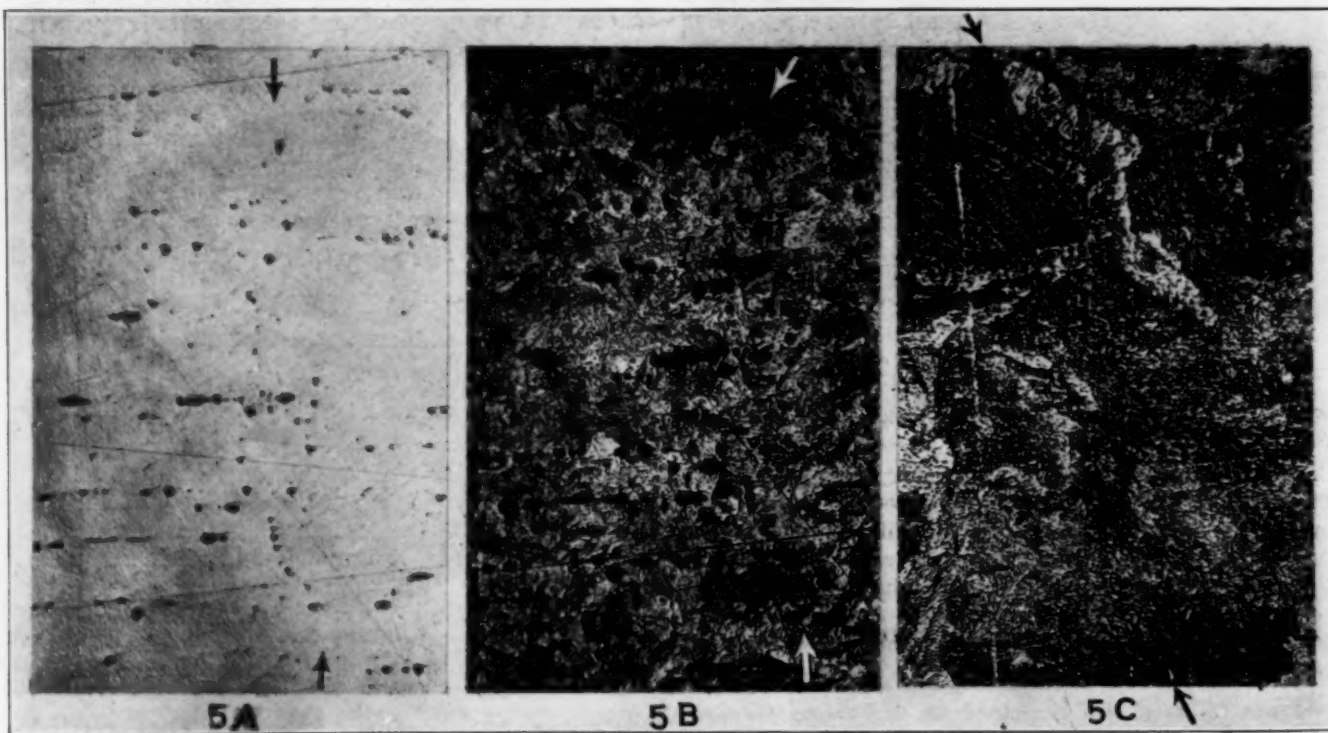


FIG. 5. MICROSCOPIC APPEARANCE OF CRACKS EXISTING IN TRANSVERSELY FISSURED RAILS

A. Crack "B" of Fig. 4; specimen is unetched. $\times 50$.
B. Same specimen as "A," etched with 2 per cent alcoholic nitric acid. The metal is in such intimate contact along the line of the defect that only a very faint indication of its presence could be obtained. $\times 50$.
C. Same specimen as "B." $\times 500$. Even at this magnification the course of the crack (indicated by arrows) is relatively very inconspicuous.

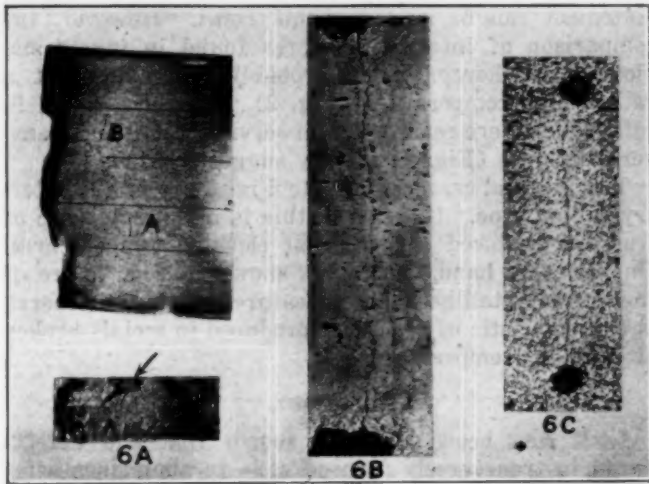


FIG. 6. NATURE OF THE INTERIOR DEFECTS REVEALED BY THE DEEP ETCHING OF RAILS CONTAINING TRANSVERSE FISSURES

Upper left—Longitudinal section of rail No. 1 (Table I) parallel to the tread. The two defects "A" and "B" were located by the magnetic method.

A. Fracture of the strip of specimen containing defect "A." The rail section was cut into strips as shown and fractured by a transverse break, along the line of the defect. The semi-circular area, indicated by the arrow, corresponds to the defect.

B. Defect "A." By means of a punch mark at each end, the crack has been opened; specimen is unetched. $\times 50$.

C. Defect "B." The crack has been opened by means of punch marks as shown. Specimen was slightly etched with 2 per cent alcoholic nitric acid. $\times 10$.

no more than $\frac{1}{4}$ in. in thickness did not reveal the presence of any unusual features.

The only method by which the defects can be located without etching the material is a magnetic one. The specimen, which must be well polished on the surface as for microscopic examinations, is magnetized and then immersed in kerosene or a similar liquid, containing very fine iron dust in suspension. "Cast-iron mud" from

disks used for lapping operations is admirable for the purpose. Particles of the iron dust collect upon the polished face of the magnetized specimen and at the places where, because of a discontinuity within the metal, a change in the density of the magnetic flux occurs, orient themselves to correspond to the shape of the discontinuity. The specimens are finally washed in clean kerosene to remove as much as possible of the excess iron dust which is scattered over the surface."

In Fig. 3 is shown the appearance of the specimen illustrated by Fig. 1, before etching.

It was given the treatment outlined above. It is extremely difficult to photograph the surface so as to show clearly the results of the treatment with iron dust. They are readily seen upon visual examination, much more so than might be inferred from the photograph. Comparison of Fig. 3 with Fig. 1, however, shows a very fine "crack" or discontinuity in the unetched sample corresponding to each of the defects found in the specimen after deep etching.

The appearance of the cracks located by the magnetic method is more clearly shown in Fig. 4, somewhat magnified, in which the surface was viewed obliquely. Crack "B" (Fig. 3) was located by means of iron dust after magnetizing the specimen. Its position was then recorded by a punch mark at each end of the crack. Fig. 4b shows the specimen after the iron dust was wiped off; no crack can be detected between the two punch marks. In Fig. 4c the same area is shown after a treatment with the iron dust. Although it is known with certainty that a discontinuity exists in the steel between the two punch marks, it is extremely difficult to find evidence of it in the microstructure even after

²This method was developed at the Bureau of Standards under the direction of Major W. E. Hoke for the inspection of precision length gages.

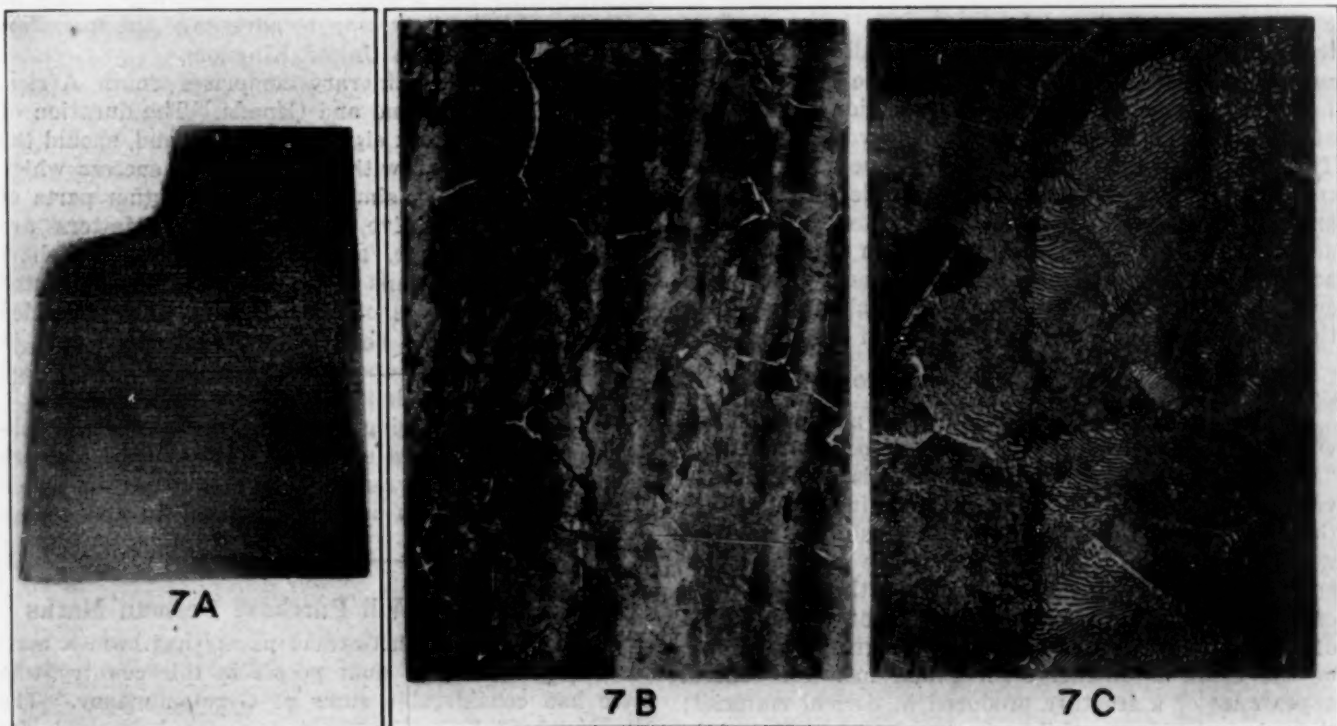


FIG. 7. MICROSCOPIC NATURE OF THE INTERIOR DEFECTS FOUND IN RAILS OF THE TRANSVERSE FISSURE TYPE

A. Longitudinal section of rail No. 2 (Table I), parallel to the tread, showing the interior cracks as they appear after slight etching with concentrated hydrochloric acid. $\times 1$.

B. Specimen "A" after slight etching in concentrated hydrochloric acid to widen the crack, repolished and etched for microscopic examination. The crack is intracrystalline in its course. There is some evidence of banding due to phosphorus. Etched with 2 per cent alcoholic nitric acid. $\times 100$.

C. Same material as "B." The intracrystalline nature of the crack is very evident. Etched with 2 per cent alcoholic nitric acid. $\times 500$.

light etching. In Fig. 5 is shown the best indication found of the presence of such a crack in the area between the two punch marks. This is very faint, however, and would be regarded in the ordinary microscopic examination as of little or no significance. The faces on the opposite sides of the discontinuity or fissure are in such intimate contact that at a magnification as high as 500 diameters the course of the crack is relatively very inconspicuous, as is shown in Fig. 5c. The course of the crack which has been indicated by arrows is hardly more conspicuous than the dark boundaries of the pearlite masses which constitute the structure of the steel. The failure of the radiographic examination to reveal these defects is due to the intimate contact between the two faces of the crack; the specimen behaves as solid metal does for this reason.

In Fig. 6 is shown a slice cut from the head of rail No. 1, parallel to the tread, in which two defects have been located by means of iron dust after magnetization of the specimen. By means of punch marks close to the ends of the cracks, it was found possible to open the fissure, as is shown in Figs. 6b and 6c. The slice containing the defects was then cut, as shown by the ruled lines, and each strip broken transversely along the line of the defect. The break was localized by means of a slight sawcut on each side in line with the crack. The appearance of the fracture is shown in Fig. 6a. A definite area which is easily distinguished from the surrounding sound material corresponds to the defect previously located. The strip containing crack "B" showed a similar characteristic spot when broken. The area, semi-circular in Fig. 6a, is identical in appearance with the nucleus of transverse fissures and with the "gray spots" often revealed in the transverse breaks of the heads of defective rails of this kind.

The nature of these defects can best be studied in material in which the carbon content is low enough so that the grain boundaries are clearly outlined by ferrite envelopes. Rail No. 2 was found to be very suitable for this purpose. Fig. 7 shows a section of this rail after slight etching with concentrated hydrochloric acid. The interior cracks having been widened by the concentrated acid, the surface was ground down, repolished and re-etched for microscopic examination. In Figs. 7a and 7b a crack is shown passing through the grains and across the grain boundaries. The cracks are intracrystalline in their course—i.e., the break has occurred through the grains rather than between them.

RESULTS OF THE EXAMINATIONS

The results of the examination given above definitely warrant the conclusion that the defects ("gashes," "fissures" or "cracks") revealed in rails of the transverse fissure type by means of deep etching exist within the material previously to the etching, as discontinuities within the steel. The function of the acid used for etching is merely to widen and deepen the *pre-existing* cracks. The microscopic appearance of these cracks offers some suggestions as to their origin. The course of the crack is intracrystalline and has the general appearance of a fracture produced in normal material; there is no evidence of inherent weakness at the grain boundaries. An answer to the question as to whether the separation occurred while the metal was cold (i.e., in the track), or while hot (i.e., in the mill), does not appear to be forthcoming from the evidence offered by the examination of the fractures alone. No definite

statement can be made on this point. However, the comparison of internal fractures found in ingots and blooms and hence, in all probability, produced at a rather high temperature (Fig. 2) with those found in rails which were removed from service because of transverse fissures (Fig. 7) is very suggestive.

The internal cracks shown in Fig. 2 are of the intercrystalline type. In general, this is a characteristic of fracture produced in metals at elevated temperatures. On the other hand, the cracks shown in Fig. 7c are of the intracrystalline type, a feature which, in general, is characteristic of fractures produced in metals broken at ordinary temperatures.

SUMMARY

1. It has been definitely shown that the defects found in transversely fissured rails in abundance after deep etching exist within the metal initially—i.e., before etching. The concentrated acid merely widens and deepens these defects.

2. These defects are internal fractures, roughly circular in area, and are of the intracrystalline type of break; otherwise, the metal appears sound.

3. These defects may be revealed with certainty before etching by magnetizing the polished specimen and then immersing it in a suspension of very fine iron dust in kerosene or a similar liquid. This method appears to be the only one for determining the presence of these and similar defects with certainty without etching the piece and thus destroying the characteristic features of the defects.

Touring Exhibition for British Industry

In the interests of British commerce in overseas markets the Department of Overseas Trade is completing arrangements for a comprehensive touring exhibition with the object of showing to advantage the manufactured products of the United Kingdom.

For a start the itinerary comprises South Africa, Australia, New Zealand and Canada. The duration of the tour will be about eighteen months, and, should the venture be attended with the degree of success which is anticipated for it, similar projects to other parts of the world will receive consideration. Matters are rapidly taking shape, and in a comparatively short space of time full details of the scheme will be submitted to the manufacturers of the country. It is intended that about 500 firms shall be invited to take part in the tour, and considerable support has already been forthcoming. Only British firms may participate.

In addition to showing the goods, the question of selling them has received attention. It is hoped to work in with the staff arrangements an agency in which orders can be taken and transmitted to the manufacturer.

Chemists' Club Will Purchase German Marks

The depreciation in German marks has been a matter of misfortune to some people in this country who have had considerable sums of German money. The Chemists' Club has recently announced through its Secretary, J. R. M. Klotz, 120 Broadway, New York City, that anyone who desires to dispose of marks at the price originally paid can do so through a plan which has been devised by the Club. Parties interested should communicate with Mr. Klotz.

Need of Co-operative Educational Work in the Chemical Industry

A Plea for Co-operative National Education in the Uses of Chlorine in Our Daily Life and Examples of the Beneficial Results Already Obtained by Co-operative Propaganda in Many Other Fields of Manufactured Products

BY JACOB G. COHEN

IN HIS work on Municipal Chemistry Prof. Baskerville showed, several years ago, the value that minute quantities of chlorine would have if added to the water with which streets are flushed. It has been urged by Albert H. Hooker in his work on Chloride of Lime and Sanitation. Here we have the greatest disinfectant known to man, at once cheap and available. And we have in the dust of our streets the bacilli of tuberculosis, tetanus, influenza and the germs that are said to be active in spreading coughs and colds, besides a lot more of the kind.

The Hazen theorem indicates that when an impure water supply in a community has been removed through the use of chlorine, the general death rate is reduced. It has been shown, where such change took place, that for every person thus saved from typhoid fever, three other persons are saved from death due to other causes usually not considered influenced by the character of the water supply. Infantile mortality caused by bronchitis, tuberculosis, pneumonia and other disturbances indicate a lowered vital resistance from the drinking of polluted water. An improved water supply forecasts increased health of the people of the community, a real tangible building up of bodily resistance to germ disease. Says George W. Fuller:

"Many sanitarians and medical men are clamoring stoutly for the elimination of all sewage matters from American streams. Literally this is impossible. No longer can there be streams of pristine purity in populous districts. This is one of the penalties of civilization.

"On the other hand, it may be freely stated that many streams are now polluted to a disgraceful degree. Corrections are most urgently needed.

"Fortunately there is now available by the hypochlorite method a reliable means of sterilizing or disinfecting sewage or water at a small cost. The full significance of this is not yet fully appreciated. It has much bearing on the question of sewage disposal in general, and in the duration method in particular, as related to some conditions."

CHLORINE'S PLACE IN OUR DAILY LIFE

Chlorine on the farm for water and sewage infection, chlorine to banish the house-fly and the many diseases that follow in its trail, chlorine for prevention of epidemics, and use in surgery and general sanitation, it ever comes in our daily life, affairs and contacts. When the full realization of its value to all humanity comes, then will its uses become more general and its production become greater.

"We are searching for an outlet for our excess chlorine in metallurgy and in organic chemicals. If our elec-

trolytic chlorine friends would begin telling people how they can live in a prophylactic environment, how they can feed their babies pure milk, and how they can avoid poisoning their neighbors who live lower down on the same watershed, conditions in the chlorine market would soon be such that they would no longer worry about what the Government is going to do with Edgewood."

This quotation from a paper on "Chemistry in Its Human Relations" read at a meeting in Buffalo indicates an essential need in the alkali industry. Increased number of buildings, increased surplus of elemental and manufactured materials, and a market that is glutted and sluggish from the standpoint of turnover mean that the chlorine people can take a leaf from the history and experiences of other industries that had the same situation to overcome. How they did it in a co-operative way will be briefly told in this paper, while the application of the principles to the problem of chlorine and its products will be but touched upon.

INDIVIDUAL VS. MUTUAL INTEREST

In the early period of American manufacture, individualism was suited to this growing stage. But the days are over when manufacturers considered that competition meant keeping to themselves everything they learned and going on their own individual paths into the markets of the country and the world. There was no regard for honorable tactics when competition was concerned, but business today has passed this stage; and for today and tomorrow and the tomorrows to come, it must be considered in its larger, greater, common grounds of mutual interest.

Industry can succeed best in this world when it renders real service, and in this opportunity for serving there will always remain individual initiative in matters of practice and competition in matters of effectiveness. This is done through the right kind of working co-operation, one which benefits the public at large by research work in facts and information gathered, and by giving the public the realization of its value through recognized media of publicity. Supplementing this general work of developmental co-operation comes creation of a code of ethics in competition, a standardization of specifications and practices in the engineering and sales management of the various companies of the industry considered with respect to the relations of any one manufacturer to all in that particular industry.

The day of organization is here, emphasized in such singularly effective manner during the period of the war—in one great industry after another the spirit of internal competition is yielding to co-operation within the ranks.

Decidedly, a condition exists in the alkali industry

which makes necessary a widening of the market. This cannot be done by one member taking away the market of another. It can be done only by a broad, effective effort to sell the American people on the uses of chlorine products, to sell more by educational efforts and thus make a better market for all. The increased volume of business will repay the small sum any one manufacturer will contribute toward such a campaign of co-operative national education.

CO-OPERATIVE ADVERTISING IN THE BUILDING MATERIALS FIELD

That this theoretical advantage of co-operative national education has proved successfully practical is attested by the fact that during recent years scores of industries in this country have organized for the joint promotion of their products. A glance through the leading journals shows the wide diversity and range of industries that are using this form of educational propaganda to increase the use of their product.

THE LUMBER INDUSTRY

The story of co-operative advertising in the lumber industry is one of continuous success. The Southern Cypress Manufacturers Association was one of the first in the field. Its annual appropriation for this purpose has been materially increased each year. In a letter from the secretary of that association, dated Sept. 27, 1917, he advises that its total revenue for promotion work during the fiscal year ended June 30, 1917, was approximately \$140,000. He makes this significant statement:

"Our subscribers, or members, have felt a most decided improvement in business conditions as a result of our advertising. Cypress stands out alone of all woods as being in the most prosperous condition. During the first half of the present year, the manufacturers of all other woods suffered a decline in prices and curtailed their production."

COMMON BRICK MANUFACTURERS

Another association of manufacturers in the building field is that which has grown out of the demands created by the war, called the Common Brick Manufacturers Association of America. The common brick manufacturers have been asleep while the lumbermen, face brick manufacturers, the cement industry and the makers of hollow tile went after increased trade and secured it. The lumbermen went after the building business. They worked with the architect, the engineer and the contractor. They furnished plans free and even helped finance buildings. So well did the lumbermen succeed with their propaganda work that today it is estimated that fully 85 per cent of all the materials used for buildings erected in the United States was sold by the lumber dealers.

To correct this condition is the object of the plans of this co-operative association. Their work will consist of paid publicity in all of the large journals, publications, and books showing the use of brick in chimneys, garden fences and other ornamental features. It will teach the common carpenter and small contractor how to build and figure a brick house. It will prepare books and publications; it will treat the proposition of building with brick in an A B C way. The big talking point is in the fact that the price of brick has increased relatively less than that of any other building material.

The brick manufacturers realize their opportunity at this time, in the fact that a brick house costs just about the same as one made of lumber and lasts a good deal longer. The association plans to follow up this opportunity in a constructive and progressive manner.

WHITE PINE BUREAU

The White Pine Bureau, composed of white pine manufacturers in the Northwest, has a large annual appropriation that it devotes to propagating the use of white pine in the building of homes. Through this campaign they have discovered the public and realized that it is the selfsame public and not the dealer or broker that is the turning factor in their interest. Their present campaign was planned for a 5-yr. period. It has been in operation so far for only three years and despite the conditions brought on during the war period they feel that their efforts were well worth while. Results of their educational work are beginning to show themselves now through increased use of their materials, and they have the satisfaction of securing wholehearted and enthusiastic co-operation from their dealers as a result of this campaign, as well as developing a new public to the use of the particular forms of building material that they manufacture.

PAINT MANUFACTURERS

The Paint Manufacturers Association of America, under the direction of its educational bureau, has completed its plans and is now at the beginning of a 5-yr. "Save the Surface" campaign which will represent a total investment of \$625,000. This educational work will be carried out in the interest of all the branches of the paint and varnish industry in a purely impartial manner and no particular material will be favored or particularly recommended at any time during this campaign. The entire object is to bring home the realization that a greater use of paint materials lengthens the life of the object on which this material is used; that in saving the surface many years are added to the life and wear of the object to which it is applied. It is purely propaganda for education, and as the realization comes of the true value of paint materials, a benefit to those who have contributed to this fund will come in the increased use of their manufacture.

PORTLAND CEMENT ASSOCIATION

Unlike the Common Brick Manufacturers Association the Portland Cement Association has been a constant user and believer of all forms of educational publicity for a good many years. This work has had much to do with the notable growth and advance of the cement industry. As indicative of the association's belief in the success of its work, its appropriation for 1917 was three times as great as the fund that was devoted to it the year previous, and that amount had increased over that of the preceding year.

MAGNETO MANUFACTURERS ACTIVE

Five important manufacturers of magnetos are united to win back the market for their product. Prior to 1911 practically every automobile was equipped with magneto ignition; but due to a variety of causes the percentage of passenger machines thus equipped dropped to 18 per cent in 1918. The reason for this slump is attributed to the strong publicity for battery ignition as well as to the neglect of the magneto manufacturers

properly to acquaint the public with the merits of their product. This work, as educational work, is supplementary to the competitive publicity used by these different manufacturers in their individual campaigns.

CO-OPERATIVE ASSOCIATION BRANDS

The advertisers of fruits, nuts and raisins, especially those situated on the Pacific Coast section of this country, have been regular and persistent developers of the general public opinion. Almost any national publication contains in its advertising section advertised fruits of the California Fruit Growers Association, "Sunkist," California Associated Raisin Co., "Sunmaid," Yakima Valley Fruit Growers Association, "Big Y," the Northwestern Fruit Exchange, "Skookum," California Walnut Growers Association, "Diamond Brand," Florida Citrus Exchange, "Sealdsweet."

OREGON PRUNE GROWERS

Even the humble prune will soon enter the market through being standardized, trade marked and advertised. The causes which led up to this action on the part of the Oregon prune growers are due to the ever-increasing production of the present bearing acreage, the realization and necessity for a standard product, the creation of markets to care for future surplus, the enormous prices and potential crop of California prunes which dominates the field, and the seemingly unnecessary price fluctuations. The problem, therefore, is what to do with this enormous increased production; how to find new markets; how to create a greater demand; and, of paramount importance, how to maintain prices on a stable "cost of production price" basis for every brand of prune there is. To secure these results it has been planned to spend over \$200,000 within the next twelve months to acquaint the general public with its graded and branded prune.

AMERICAN CRANBERRY EXCHANGE

The American Cranberry Exchange is a co-operative organization of cranberry growers supported by assessments levied upon its members, which include the leading growers of fruit. It controls distribution and has created an artificial demand for cranberries, that is, created a demand other than that created by the age-old custom of serving cranberry sauce with the turkey on Thanksgiving. In this connection it is interesting to know that the general manager of the exchange in his annual report said: "With an adequate amount of publicity an artificial demand can be created sufficient to consume the largest possible crop." This is especially interesting because before the advent of any national cranberry advertising the growers experienced a number of bad years when the crop was heavy and the demand was light.

LAUNDRY MACHINERY

Appreciating the fact that its success is bound up with the industry it serves, the American Laundry Machinery Co. has launched a campaign which it expects to conduct over a period of at least three years to inform the housewives of America, as simply and pleasantly as it may, the advantages of modern laundry methods over the old-time washboards and the mess and worry of wash day. The campaign also contemplates a hard and continuous drive to protect the industry and to protect as far as possible the further inroads of manufacturers of home power laundry equipment by

getting before the housewives the laundries' side of the story. The campaign which has been worked out for developing a legitimate market open to the industry is largely educational. An analysis of the potential market leads the company to believe that fully one-half, or 10,000,000, of the homes in the United States can be considered as possible patrons of the laundries. Estimated surveys show that if each of these homes were to send a bundle of home work each week amounting to \$2 (which is low), it would mean a total volume for the laundries each year of \$1,040,000,000.

AUTOMOTIVE WOOD WHEEL MAKERS

The Automotive Wood Wheel Manufacturers' Association spent \$70,000 in 1918, and will spend as much or more this year to put wood wheels back in the place they held before wire wheels were so widely advertised. If those manufacturers of wood wheels had begun earlier, their appropriation would have had more value. Now they have to meet opposition. Once they could have simply maintained the good will built up by years of use of wood wheels on horse-drawn vehicles.

STONE QUARRY PRODUCTS

The Barre Quarries and Manufacturers Association spends \$75,000 annually on a product that has not one-tenth the appeal that can be made by alkali products. It has advertised for three years and the results are now beginning to show to full advantage. It pays 5 per cent of its gross income into the fund.

TOBACCO GROWERS

The New England Tobacco Growers Association, representing the growers in the Connecticut Valley, has decided to advertise nationally in order to develop a proper appreciation for tobacco, especially wrappers, produced in that section of the country. It is reported that dealers as well as farmers are interested in this project. No amount has yet been determined, but it will be prorated according to the number of acres.

THE COOPERAGE INDUSTRY

A fund of \$300,000 for a 3-yr. educational campaign in favor of the use of slack barrels is now being raised by the Associated Cooperage Industry of America. Says F. S. Charlot, chairman of the committee:

"We think the slack barrel as a container for food products is better than some of the other containers now in use. We believe if the public could visualize the unsanitary experiences of a sack of flour or sugar, they would prefer to go to the grocer and have that small quantity dispensed from a clean, sanitary wooden barrel that has protected the contents from contamination. If the public choose to go to their grocer and insist that the flour or sugar be dispensed that way it will eventually be done."

SPREADING GOSPEL OF "SAFETY FIRST"

"Safety First" is a phrase that is familiar to everybody, but few members of the public stop to think who created the slogan and who made it possible. The answer in both cases is the National Safety Council, with headquarters in Chicago, which is spending a large sum each year to spread the gospel of accident prevention. Most of this fund goes for printed matter, because they believe their problem is entirely one of education and continued publicity. The Council was started five years ago and in that brief period it has built up an or-

ganization of 3,758 members, including 150 industries employing over 6,000,000 workmen. The Council has sought to reach these workmen and their employers with fact messages that would get co-operation from all those affected.

LABOR UNION TO ADVERTISE WOOD CARVING

An old industry, wood carving, is to be advertised by its labor union, the International Wood Carvers Association. The purpose of this publicity is to bring home to the American people the fundamental facts about hand-carved wood and to show that wood carving, into which the best efforts of skilled men have gone, is better than machine-made wood. The true motive is to gain the patronage of the wealthy and the artistic for the hand-carved product, that the craft may revert to its former high place among the arts.

THE CANNERS' CAMPAIGN

A new educational campaign is now being conducted by the canners of the United States. This is contemplated to last four years and the approximate cost for this period will be about \$2,000,000. The form of the campaign will be to heighten the prestige of canned goods as a steady article of diet. The maximum public good will is to be openly and candidly sought in behalf of the entire industry. The canners mean to lay their products and processes on the table and invite public inspection and examination. They want to correct the misinformed and dissipate prejudice.

It is intended that the campaign shall have the following results: A united industry, universality of food of higher standards, larger production, larger consumption, service to the public, and greater confidence of the consumers. Special committees and divisions have been appointed to take care of the different sections of the work. Surrounding them are the various subdivisions which have to do with laboratory work, legal work, finance, inspection, etc.

One part represents the educational and information section and has charge of compiling authentic information concerning all branches of activity in the industry. The second part deals with home economics and spreads the story of canned goods through schools, clubs, stores, conventions, etc., by means of addresses, lectures and demonstrations. It will also have charge of promotion, which will include personal interviews and correspondence with officials, firms, the trade and the members of the industry itself, with addresses at conventions of the industry and of the trade.

Still another section covers the actual educational work that is done by the committee in the way of general publicity, together with investigative work among canners, consumers, dietitians, physicians, pure food reports, food law officials and many other classes. No effort will be spared to show the housewife the healthfulness and safety of canned goods and the care and study given their proper production. It is believed their consumption will be vastly increased.

IN UNION THERE IS STRENGTH

These are the illustrations of manufacturers, all of them in competing lines, who are willing to forget fear and jealousy and work together for the common good. They are merging their various individual educational efforts into a common hold to develop and enlarge the market for their product. These men are competitors and will remain so, but they are proceeding on the

theory that the more information and the more propaganda they conduct on their particular products, the better it is going to be for everybody in the industry. Manufacturers when disposed to shy at co-operative efforts in the way of marketing and advertising can well afford to learn a lesson from the labor unions. Statisticians tell us that organized labor comprises only about 7 per cent of the country's population. Despite the small proportion, note the way the labor unions win out time and again. They win because they adopt a policy and then go through with it. Whatever may be the criticism of their methods, it must be admitted that they stand together for their common cause.

BUSINESS EXPANSION AND MARKET SATURATION

In considering the trade in chemicals, the amount of the trade should not be regarded as a fixed volume of business, but one capable of unlimited expansion, bounded only by the character of the business administration and the study of business conditions, trade opportunities, sales, etc. The limit is reached only when the market has topped the saturation point. Has this point been reached in the use of chlorine for water treatment and disinfection purposes? A paralleling of towns using chlorine products for this purpose with those that do not would bring forth the comparison. As an illustration of a similar condition, though in a dissimilar field, Chairman Hurley of the Shipping Board relates an incident in his own business when he centered a lot of energy on a special sales campaign.

Money was spent in advertising and saleswork, new territory was entered and new customers secured. Results exceeded his expectations. He increased his output, distribution and profits and at the same time reduced his manufacturing and selling costs.

None of his competitors lost any business, however. In fact, by his educational work they gained many new dealers and consumers. He said that it is as if some one suggested that new railroad lines of freight cars to carry goods might take business away from somebody, for we all understand that trade is something to be expanded, something that grows by opening up new territory, by finding new uses, spreading new ideas. It will grow through intensive development, as is done on other products, through advertising, sales, organization and co-operative work generally, whereby business will be created by cultivating the natural desire of every human being for a better standard of living.

CONCLUSION

Co-operative educational propaganda has tremendous possibilities. It makes a broader and wider market for the entire products and industry through an increase in demand; stabilizes and steadies the market, and makes it less affected by trade depressions and other similar conditions; creates a market for general production before it tries to sell the particular commodity. It lessens the bitterness of competition and advertises the health and strength of the entire industry.

There is opportunity at the present time for co-operative educational work on the greater use of alkali products. To lower the death rate, to make living conditions better and more pleasant, to benefit all mankind—this is the opportunity and the work that is to be done, done in the same way and in the same manner that the various individual industries of this group have been built up, and the results can be considered certain of success.

Industrial Alcohol Under the New Law and Regulations

An Interpretation of the Industrial Aspects of the National Prohibition Act and Regulations 60 and 61—
Authorized Uses of Intoxicating Liquors—Procedures—Tax-Free and Completely
and Specially Denatured Alcohol—Formulas and Applications

By BURNELL R. TUNISON

BECAUSE of the general misconceptions on the part of the public, and of chemists and manufacturers in particular, concerning the recent national prohibition act and the regulations recently promulgated by the Internal Revenue Bureau for carrying out the provisions of this act, it seems advisable at this time to attempt to explain the essential features of this act and these regulations and indicate in a general way the fundamental changes which will take place due to their operation.

Most people imagine that the national prohibition act has but one aim to accomplish; namely, to prohibit the use of alcohol as an intoxicating beverage. This was the primary consideration, but it may be seen from the title of the act itself that Congress had another aim of almost equal importance. Congress, after mature deliberation and after the passage of most of the features involved in the act itself, decided to call the act as follows:

An act to prohibit intoxicating beverages, and to regulate the manufacture, production, use and sale of high-proof spirits for other than beverage purposes and to insure an ample supply of alcohol and promote its use in scientific research, and in the development of fuel, dye and other lawful industries.

DUAL PURPOSE OF THE ACT

It will be noted that one of the purposes of the act is to insure an ample supply of alcohol and promote its use in the lawful industries.

In order to carry out the provisions of this act the United States Treasury Department, through the Bureau of Internal Revenue, has issued regulations. These have been issued in two parts: Regulations 60 relating to the manufacture, sale, barter, transportation, importation, exportation, delivery, furnishing, purchase, possession and use of intoxicating liquor; and regulations 61 relating to the production, tax payment, etc., of industrial alcohol and to the manufacture, sale, and use of denatured alcohol.

Most people think that the above-mentioned regulations 60 concern that alcohol which may be used as beverage and that regulations 61 concern all alcohol which is used industrially. It is the writer's opinion that this should be the case, but unfortunately this is not the arrangement made by the powers at Washington. Regulations 60 concern intoxicating liquors, in which the Government has included all pure alcohol used industrially upon which tax is paid. Thus manufacturers of pharmaceuticals or chemical manufacturers who are producing lawful goods which are unfit for beverage purposes and who because of the nature of their product and process cannot use alcohol denatured under formulas prescribed by Government regulations are therefore forced to obtain their alcohol under regulations 60, pay a tax of \$4.18 per gal. and be subjected to all the restrictions, red tape, delays, etc., as though

they were users of whiskey. Why should these manufacturers be subject to whiskey regulations and taxes any more than a hospital, or college, or a manufacturer of varnish? This red tape is so extensive and the delays which accompany it are so great as to be next to impossible for the busy manufacturer. If any possible substitutes for this alcohol can be discovered, even though they are inferior to alcohol, they will undoubtedly be used.

AUTHORIZED USES OF INTOXICATING LIQUORS

Regulations 60 provide that intoxicating liquors may be manufactured, sold, bartered, transported, imported, exported, delivered, furnished, purchased and possessed, and used for non-beverage purposes as indicated below, under the conditions and requirements of the regulations.

1. Manufacture of medicinal preparations in accordance with formulas prescribed by the U. S. Pharmacopoeia, National Formulary, or the American Institute of Homeopathy, which are unfit for beverage purposes and in the manufacture of other patented, patent, proprietary and other medicines which are unfit for beverage purposes and certain medicinal preparations which are fit for beverage purposes.

Such preparations must contain no more alcohol than is necessary for the purpose of extraction, solution, or preservation and must contain in each fluid ounce a dose as a whole or in compatible combination of one or more agents of recognized therapeutic value and contain no agents either chemically or physiologically incompatible with the active medicinal agents upon which the medicinal claims are based.

2. By retail druggists or pharmacists in the compounding of medicinal preparations unfit for use for beverage purposes on physicians' prescriptions, and for dispensing as such for medicinal purposes upon physicians' prescriptions.

3. By physicians in the practice of their profession.

4. By persons conducting hospitals and sanatoriums for medicinal, scientific, and manufacturing purposes.

5. (Potable distilled spirits only.) In manufacturing and industrial establishments for first-aid treatment.

6. (Rum only.) In the manufacture of denatured rum as provided by regulations 30.

7. In the manufacture of denatured alcohol as provided by regulations 61.

8. In the manufacture of toilet and antiseptic preparations and solutions that are unfit for use for beverage purposes.

9. In the manufacturing of flavoring extracts and sirups that are unfit for use as beverages or for intoxicating-beverage purposes.

10. For medication by druggists or pharmacists.

11. For laboratory purposes and in general manufacturing and technical processes.

12. By dentists and veterinarians in the course of their practice.

13. (Tax-free alcohol.) By the United States or any governmental agency thereof, or by the several states and territories or any municipal subdivision thereof, or by the District of Columbia, or for the use of any scientific university or college of learning, any laboratory for use exclusively in scientific research, or for use in any hospital or sanatorium.

14. For conversion into beverages containing less than one-half of one per centum of alcohol by volume, as provided by the regulations.

15. For sacramental purposes or like religious rites, as provided in the regulations.

16. In the manufacture of beverages containing less than one-half of one per centum of alcohol by volume under the procedure outlined in the regulations. Provided, however, that intoxicating liquors produced for this purpose may not be exported.

17. In the manufacture of other alcoholic medicinal preparations which are unfit for beverage purposes according to the standards prescribed in the regulations.

18. By retail druggists or pharmacists in the compounding of medicinal preparations unfit for use as beverages on physicians' certificates and for dispensing as such for medicinal purposes upon physicians' prescriptions.

19. By persons conducting hospitals and sanatoriums, for medicinal purposes.

20. By physicians for administering to patients in the practice of their profession.

21. In the production of vinegar as provided in the regulations.

PROCEDURE NECESSARY IN ORDER TO USE TAX-PAID ALCOHOL

In brief the procedure necessary for a manufacturer to obtain pure alcohol for industrial purposes is as follows:

1. Application must be made to the Federal prohibition director in the state in which the manufacturer desires to use the alcohol (form 1,404 in triplicate). This application after being approved by the director is forwarded to the Federal prohibition commissioner, who may approve the application and issue the permit (form 1,405) to use non-beverage alcohol. Every permit clearly and specifically designates and limits the acts that are permitted and the time when, and the place where such acts may be permitted. It is necessary to make application for each individual purchase, be it for one 10-gal. can or a carload, and have these permits renewed in accordance with the regulations.

2. A bond must accompany the above application (form 1,408 or form 1,409 in duplicate) to insure compliance with the provisions of the act and the regulations. The basis of the penal sum of the bond is \$4.20 per proof gallon of distilled spirits. The penal sum of the bond is fixed at approximately twice the sum of the United States internal revenue tax on the alcohol involved. The rate of tax on distilled spirits for non-beverage purposes is fixed by section 600a of the revenue act of 1918, approved Feb. 24, 1919, at \$2.20 on each proof gallon [which is equivalent to \$4.18 on each wine gallon (231 cu.in.) of 95 per cent alcohol] or wine gallon when below proof, and a proportionate tax at a like rate on all fractional parts of such proof or wine gallon. In no case the penal sum of any bond can be less than \$1,000 nor more than \$100,000. The bond must be recommended by the Federal prohibition director and referred to the Federal prohibition commissioner. The bond must then be approved by the Federal prohibition commissioner before the manufacturer can obtain a permit to purchase alcohol.

3. After the above permit and bond have been approved it is necessary to make application to the Federal prohibition director for a permit to purchase non-beverage alcohol. Application for permit to purchase must be made on form 1,410 (in triplicate—where transportation is involved four or more copies must be provided). The application must be sworn to before a notary or other person authorized to administer oath, and when approved by the Federal prohibition director

becomes a permit. The applicant must describe in particular alcohol to be received by him and must in all cases give the quantity in wine gallons, also in proof gallons, of each kind of liquor on hand at the date of application, and previously received by him during the current calendar year and also since the first day of the quarterly period. Each application must show the name and address of the vendor from whom he proposes to buy, the number of the permit to use alcohol held by the applicant and the address of the premises where the alcohol is to be used. The applicant must be certain that his bond covers the quantity of alcohol outstanding as a debit against the bond, at all times. The permit when approved is forwarded to the vendor who is to furnish the alcohol. It is then possible for the vendor to ship the alcohol to the manufacturer. The vendor must keep careful records, fill out and return a copy of the permit to the director and make reports of all such sales within a specified time. The vendor must send a copy of form 1,410 to the vendee, who must retain it as a permanent record of all such transactions. These permits to purchase for the purpose of manufacturing or selling expire in ninety days after date of approval. Other permits to purchase expire in thirty days.

It is necessary to obtain such a permit for every shipment and the amount required or authorized on each permit must be shipped at one time.

After going through the above procedure the manufacturer may use the alcohol obtained. It is obvious that all this procedure will do very well to cover the purchase of a bottle of whiskey, but it is a real hardship for the persons who purchase alcohol in quantities for lawful manufacturing purposes. In order to carry out these regulations the new office of Federal prohibition director has been created. The Collectors of Internal Revenue, who have had the handling of the tax-paid alcohol regulations, have been relieved of this duty. This new office is not familiar with the handling of this business, it has no uniform methods of procedure, and it is not too much to expect that the user of tax-paid alcohol will suffer long delays in addition to those necessarily experienced due to the Post Office Department in forwarding permits, bonds, etc., from place to place.

TAX-FREE ALCOHOL

Pure ethyl alcohol may be withdrawn free of tax for export under regulations, provided this alcohol is to be used for non-beverage purposes. A permit to export such alcohol may be obtained by making application to the Federal prohibition director (form 1,404 in triplicate) who may approve the application and forward it to the Federal prohibition commissioner, who may approve and issue the permit (form 1,405). Alcohol may then be exported, under further regulations.

Pure undenatured alcohol may be obtained tax free for use under Section 11 of Title III of the national prohibition act, which provides as follows:

Alcohol may be withdrawn under regulations from any industrial plant or bonded warehouse tax free, by the United States or any governmental agency thereof, or by the several states and territories, or any municipal subdivision thereof, or by the District of Columbia, or for the use of any scientific university or college of learning, any laboratory for use exclusively in scientific research or for use in any hospital or sanatorium.

But any person permitted to obtain alcohol tax free, except the United States and the several states and territories and subdivisions thereof, and the District of

Columbia, must first apply for and secure a permit to purchase the same and give the bonds prescribed for in the case of tax-paid alcohol previously described, but alcohol for use by the United States and the states, territories and subdivisions thereof, and the District of Columbia may be purchased and withdrawn subject only to such regulations as may be prescribed.

Under the provisions of law above referred to the privilege of withdrawing alcohol in bond, free of tax, is held to apply to all scientific or educational institutions incorporated or organized under any Federal, state, or territorial law, or any colleges of learning which have a recognized curriculum and confer degrees after specified periods of attendance at classes or research work, upon proper showing of the facts, any laboratory for use exclusively in scientific research, or to any permanently established hospital or sanatorium in good standing, whether operated for profit or not.

Alcohol withdrawn as above provided may be used in the case of hospitals or sanatoriums only for medicinal, mechanical, and scientific purposes and in the treatment of patients. Scientific or educational institutions or colleges of learning must use such alcohol only for mechanical and scientific purposes, and any laboratory withdrawing alcohol free of tax must use same exclusively in scientific research. The use of the alcohol and resulting products is confined strictly to the premises of the institution withdrawing the alcohol, and in no case is the alcohol to be used in the preparation of food products for use in the institution or elsewhere, nor can products for sale be made from the alcohol withdrawn as above provided.

From the above it may be seen that colleges, universities, hospitals and sanatoriums may obtain tax-free alcohol.

Any laboratory may obtain tax-free alcohol for use exclusively in scientific research.

PROCEDURE TO USE TAX-FREE ALCOHOL

Where it is desired to withdraw alcohol, tax free, as above indicated, it is necessary to proceed as follows:

1. An application (form 1,447 in quadruplicate) must be made to the Commissioner of Internal Revenue for a permit to use such alcohol. This application when approved by the Commissioner constitutes the permit.

2. At the time of filing the above application the applicant should give bond (form 1,448 in duplicate) in a sum sufficient to cover double the tax at the non-beverage rate on all alcohol at any time on hand, in transit, or unaccounted for, but at no time may the bond be for less than \$1,000.

3. Make application to the proper Collector of Internal Revenue for a withdrawal permit (form 1,449). The United States or any governmental agency thereof must make application direct to the Commissioner of Internal Revenue (form 1,444). Applications by any state or territory or by the District of Columbia must be made to the proper Internal Revenue Collector (form 1,445). This latter procedure also applies to any municipal subdivision of any state or territory, which in addition is required to file the regulation bond for twice the sum of the non-beverage tax. A permit (form 1,450) will be issued which permits obtaining alcohol free of tax for the year, and for the amount covered by the penal sum of the bond.

It is necessary for institutions securing such tax-free alcohol to make a monthly statement (form 1,451) of the amount of alcohol received, on hand, used, etc.

DENATURED ALCOHOL

Alcohol when suitably denatured was first allowed tax free under the act of June 7, 1906, which provides in part:

That from and after Jan. 1, 1907, domestic alcohol of such degree of proof as may be prescribed by the Commissioner of Internal Revenue, and approved by the Secretary of the Treasury, may be withdrawn from bond without the payment of internal-revenue tax, for use in the arts and industries and for fuel, light and power provided said alcohol shall have been mixed in the presence and under the direction of an authorized Government officer, after withdrawal from the distillery warehouse, with methyl alcohol or other denaturing material or materials, or admixture of the same, suitable to the use for which the alcohol is withdrawn, but which destroys its character as a beverage and renders it unfit for liquid medicinal purposes: such denaturing to be done upon the application of any registered distillery in denaturing bonded warehouses specially designated or set apart for denaturing purposes only, and under conditions prescribed by the Commissioner of Internal Revenue with the approval of the Secretary of the Treasury.

The amendatory act of March 2, 1907, permitted the use of denatured alcohol in the manufacture of ether and chloroform and other definite chemical substances where the alcohol is changed into other chemical substance and does not appear in the finished product as alcohol.

Prior to the enactment of the national prohibition act the internal revenue tax on distilled spirits (ethyl alcohol, whiskey, brandy, rum, gin, etc.) was \$6.40 per proof gallon—50 per cent alcohol by volume—when used for beverage purposes, and \$2.20 per such proof gallon when used for non-beverage purposes. Ethyl alcohol was then tax free only when withdrawn from bonded warehouse exclusively for export, or by the United States Government or scientific universities and colleges of learning, or for use in the arts and industries and for fuel, light and power when denatured "with methyl alcohol or other denaturing material or materials, or admixture of the same suitable to the use for which the alcohol is withdrawn but which destroys its character as a beverage and renders it unfit for liquid medicinal purposes." (The quotation is from the original denatured alcohol act of June 7, 1906.)

The national prohibition act under Title III not only extended the use of tax-free ethyl alcohol to "the several states and territories or any municipal subdivision thereof or by the District of Columbia, or any laboratory for use exclusively in scientific research, or for use in any hospital or sanatorium," but said act furthermore provided that alcohol shall also be tax free when denatured "by the admixture of such denaturing materials as shall render the alcohol or any compound in which it is authorized to be used unfit for use as an intoxicating beverage," thus eliminating the restriction against the use of such tax-free denatured alcohol for "liquid medicinal purposes," contained in the aforesaid act of June 7, 1906, and reconciling the definition of denatured alcohol with that established for intoxicating liquor in Title II of the national prohibition act. This act under Title III provides that "alcohol lawfully denatured may, under regulations, be sold free of tax either for domestic use or export."

"Intoxicating liquor" is defined in the national prohibition act to mean practically all substances "containing one-half of one per centum or more of alcohol by volume which are fit for use for beverage purposes," and as the Government is itself fixing standards under such definition, it follows that a manufacturer requiring al-

cohol for non-beverage purposes, i.e., in the production of commodities which are not fit for use for beverage purposes, is lawfully entitled to tax-free alcohol denatured in accordance with formulas suitable for his needs. Expressed differently, lawful products must be made "unfit for use as an intoxicating beverage," and *ipso facto*, they come within the class of industries in which tax-free denatured alcohol may be used under Title III of said act. This construction is sound in principle both from the legal and economic standpoints and, when effectuated by regulations of the Internal Revenue Bureau, will not only remove the present unfair and discriminatory tax upon an essential raw material when used in the manufacture of pharmaceuticals and other articles which are equally important to national welfare as those which now enjoy tax-free alcohol, but will have a salutary effect upon the "H. C. of L." by reducing the price of medicines and other necessities of life and otherwise placing United States chemical industries upon a plane of efficiency which will enable them to compete successfully with foreign goods in the markets of the world.

COMPLETELY DENATURED ALCOHOL

In order to carry out the provisions of the act the Internal Revenue Bureau has authorized the following completely denatured alcohol formulas:

1. This formula, which consisted of 100 parts of ethyl alcohol and 10 parts of methyl alcohol and $\frac{1}{2}$ part benzene, has been suspended.

2. To every 100 parts by volume of ethyl alcohol there shall be added 2 parts by volume of approved wood

alcohol and one-half of 1 part by volume of approved pyridine bases.

3. To every 100 parts by volume of ethyl alcohol add 5 parts by volume sulphuric ether, 2 parts by volume benzene, and 1 part by volume pyridine.

4. To every 100 parts by volume of ethyl alcohol there shall be added: 2.5 parts by volume of approved benzol, 0.5 part by volume of nitrobenzol, 0.2 part by volume of approved pine oil (steam distilled).

5. To every 100 parts by volume of ethyl alcohol there shall be added: 2 parts by volume of approved wood alcohol, $\frac{1}{2}$ part by volume of approved pyridine bases, $\frac{1}{2}$ part by volume of approved benzene (kerosene).

The denaturing materials used are subject to regulation and their specifications may be found in regulations 61, p. 97 et seq.

Alcohol when denatured as above may be used without restriction or regulation except as to marking of containers and is not subject to tax.

SPECIALLY DENATURED ALCOHOL

A manufacturer desiring to use specially denatured alcohol for manufacturing purposes must file an application for a permit (form 1,479 in duplicate). The application must contain a description of the location and construction of the storeroom or storerooms in which the manufacturer proposes to store the alcohol, also an explanation in detail as to how the alcohol is to be used. A bond must be filed to insure compliance with regulations, the bonds being not less than \$500 nor more than \$100,000, in accordance with the schedule shown in Table II.

The formulas of specially denatured alcohol which have been authorized up to the present are as shown in Table I.

TABLE I. AUTHORIZED FORMULAS OF SPECIALLY DENATURED ALCOHOL

(The ethyl alcohol used in these formulas is of 190 deg. proof, or 95 per cent.)

(1) 100 gal. ethyl alcohol. 5 gal. methyl (wood) alcohol.	(13a) 100 gal. ethyl alcohol. 10 gal. sulphuric ether.
(2) 100 gal. ethyl alcohol. 7 lb. camphor. 5 lb. methyl alcohol (refined).	(14) 100 gal. ethyl alcohol. 5 gal. methyl alcohol (refined). 10 lb. anhydrous zinc chloride.
(2a) 100 gal. ethyl alcohol. 2 gal. methyl alcohol. 2 gal. benzol.	(15) 100 gal. ethyl alcohol. 3 gal. sulphuric acid. 1 gal. kerosene.
(2b) 100 gal. ethyl alcohol. $\frac{1}{2}$ gal. benzol.	(16) 100 gal. ethyl alcohol. 5 gal. methyl alcohol (refined). 2 gal. benzol.
(3) 100 gal. ethyl alcohol. 5 gal. following mixture: 5 gal. methyl alcohol (refined). 1 gal. castor oil, $\frac{1}{2}$ gal. of 36 deg. B. caustic soda lye.	(17) 100 gal. ethyl alcohol. 5/100 gal. (6 $\frac{1}{2}$ fluid oz.) animal oil (Dipple's oil).
(3a) 100 gal. ethyl alcohol. 5 gal. methyl alcohol (refined).	(18) 100 gal. ethyl alcohol. 100 gal. vinegar (not less than 9 per cent acetic acid).
(3b) 100 gal. ethyl alcohol. 1 gal. liquid pine tar.	(19) 100 gal. ethyl alcohol. 100 gal. ethyl ether.
(4) 100 gal. ethyl alcohol. 1 gal. following solution: 5 gal. aqueous solution containing 40 per cent nicotine; 0.4 lb. acid yellow dye (fast yellow Y); 0.4 lb. tetrazo brilliant blue, 12 B, conc.; water to make 100 gal.	(20) 100 gal. ethyl alcohol. 5 gal. crude chloroform.
(4) 100 gal. ethyl alcohol. 1 gal. following solution: 5 gal. aqueous solution containing 40 per cent nicotine; 3.6 oz. more or less, of methylene blue; water to make 100 gal. (This is an alternative for formula 4 above.)	(21) 100 gal. ethyl alcohol. 100 gal. solution containing not less than 4 $\frac{1}{2}$ per cent acetic acid.
(5) 100 gal. ethyl alcohol. 65 lb. sulphuric ether. 3 lb. cadmium iodide. 3 lb. ammonium iodide.	(22) 100 gal. ethyl alcohol. 10 gal. solution of formaldehyde.
(6) 100 gal. ethyl alcohol. 3 gal. methyl alcohol (refined). $\frac{1}{2}$ gal. pyridine bases.	(23) 100 gal. ethyl alcohol. 10 gal. acetone. 2 gal. benzol.
(6a) 100 gal. ethyl alcohol. 15 gal. condensed fumes, recovered in the process of manufacture. (Fulminate of mercury.)	(24) 100 gal. ethyl alcohol. 29 gal. sulphuric acid.
(6b) 100 gal. ethyl alcohol. $\frac{1}{2}$ gal. pyridine bases.	(25) 100 gal. ethyl alcohol. 25 lb. iodine.
(7) Revoked (formula 1 substituted).	(26) 100 gal. ethyl alcohol. 5 gal. aniline oil.
(8) 100 gal. ethyl alcohol. 1 gal. pyridine bases. 1 gal. benzol.	(27) 100 gal. ethyl alcohol. 1 gal. oil rosemary. 30 lb. camphor.
(9) 100 gal. ethyl alcohol. 10 gal. acetone. 2 gal. petroleum naphtha.	(27a) 100 gal. ethyl alcohol. 35 lb. camphor. 1 gal. oil cloves.
(10) 100 gal. ethyl alcohol. 2 gal. methyl alcohol. 2 gal. benzol.	(28) 100 gal. ethyl alcohol. 10 gal. benzol.
(11) 100 gal. ethyl alcohol. 100 lb. sulphuric ether. 10 lb. cadmium iodide.	(29) 100 gal. ethyl alcohol. 5 gal. alcoholic solution acetaldehyde.
(12) 100 gal. ethyl alcohol. 1 gal. pyridine bases. 2 gal. benzol.	(30) 100 gal. ethyl alcohol. 10 gal. methyl alcohol (refined).
(12a) 100 gal. ethyl alcohol. 5 gal. benzol.	(31) 100 gal. ethyl alcohol. 100 lb. soap. 100 lb. glycerine.
(13) 100 gal. ethyl alcohol. 5 gal. sulphuric acid. 5 gal. sulphuric ether.	(31a) 100 gal. ethyl alcohol. 100 lb. glycerine. 20 lb. hard soap.
	(31b) 100 gal. ethyl alcohol. 5 $\frac{1}{2}$ gal. oil peppermint. 14 gal. eucalyptol. 4 lb. menthol crystals.
	(32) 100 gal. ethyl alcohol. 5 gal. sulphuric ether.
	(33) 100 gal. ethyl alcohol. 30 lb. methyl violet.

TABLE II. RATIO OF THE PENAL SUM OF THE BOND

Less than 100 wine gallons.....	\$500
100 to 200 wine gallons.....	1,000
201 to 425 wine gallons.....	2,000
426 to 650 wine gallons.....	3,000
651 to 900 wine gallons.....	4,000
901 to 1,100 wine gallons.....	5,000
1,101 to 2,200 wine gallons.....	10,000
2,201 to 3,250 wine gallons.....	15,000
3,251 to 4,400 wine gallons.....	20,000
4,401 to 5,250 wine gallons.....	25,000
5,251 to 6,600 wine gallons.....	30,000
6,601 to 7,750 wine gallons.....	35,000
7,751 to 8,900 wine gallons.....	40,000
8,901 to 10,000 wine gallons.....	45,000
10,001 to 11,000 wine gallons.....	50,000
11,001 to 12,000 wine gallons.....	55,000
12,001 to 13,000 wine gallons.....	60,000
13,001 to 14,250 wine gallons.....	65,000
14,251 to 15,400 wine gallons.....	70,000
15,401 to 16,500 wine gallons.....	75,000
16,501 to 17,800 wine gallons.....	80,000
17,801 to 18,800 wine gallons.....	85,000
18,801 to 20,000 wine gallons.....	90,000
20,001 to 21,000 wine gallons.....	95,000
More than 21,000 wine gallons.....	100,000

To the user of large quantities of specially denatured alcohol the new schedule represents quite an advantage over the old regulations in that if the manufacturer files a bond for \$100,000 he can use any quantity of alcohol he may desire.

Another decided improvement in the present regulations over the old is in the fact that it is now not necessary to renew the withdrawal permits. Manufacturers found under the old regulations that the delays necessary in sending the withdrawal permits from place to place and the delays in renewing withdrawal permits constituted a serious handicap in the continuity of their plant operation. Under regulations 61 once the permit is given it stands until revoked or surrendered.

The formulas of specially denatured alcohol given in Table I have been authorized for use in various products and industries as indicated in Table III.

TABLE III. PRODUCTS AND INDUSTRIES AUTHORIZED TO USE SPECIALLY DENATURED ALCOHOL

FORMULA 1	
Acetaldehyde.	Gum and pyroxylin solutions.
Acetphenetidine.	Galloyanine.
Acetic ether.	Gas mantles.
Aconite.	Hats.
Adeps lanæ.	Hellotropin.
Alkaloids and alkaloidal salts.	Hydrastis (alkaloid of).
Alertrin.	Hexachlorbenzol.
Alolin.	Inks.
Antipyrin.	Inulin and Iriscin.
Apocynin.	Imitation leather.
Arbutin.	Isinglass.
Asclepiadin.	Imitation ivory goods.
Avenin.	Jalapin (nonliquid concentration of).
Artificial flowers.	Jewelry and watches.
Ammunition.	Japans.
Atophan.	Lacquers, pastes, and varnishes from soluble cotton.
Aspirin.	Leather substitutes.
Acetanilid.	Leather-goods finish.
Artificial feathers.	Lacquers.
Baptisin.	Liquor cresolis compound.
Barometer and thermometer tubes.	Mandrake (powdered and solid extract of).
Benzoic acid.	Mirrors.
Benzaldehyde.	Moldings and picture frames.
Beta naphthol.	Monobromated camphor.
Beta naphthol benzoate.	Moth repellent.
Brushes.	Mica insulators.
Benzidine.	Mucilage, paste, and glue.
Beta-naphthol salicylate.	Motor fuel.
Benzy cyanide.	Nonscatterable glass.
Benson.	Nitroso betanaphthol.
Chelonin.	Orthotoluolsulphamide.
Cimicifugin.	Oils, greases, lubricants, and soluble thread-cutting oils.
Collodion.	Oleoresins.
Collodion corn remedy.	Paints.
Concentrations (nonliquid).	Phenolphthalein.
Confectioner's colors.	Phytolacin (concentration of).
Coumarin.	Photographic dry plates and films.
Cutlery.	Print paper and enlargements.
Cocoa butter.	Postal-card colors.
Composition billiard and pocket balls.	Polish preparations for metals and furniture.
Chloroform.	Pepsin and similar products.
Compasses.	Potassium hydroxide.
Cresote carbonate.	Podophyllin resin and similar products.
Colors and bronze powders.	Powdered drugs and extracts.
Chloral hydrate.	Photographic engravings.
Camphor, synthetic.	Phenyl cinchoninic acid.
Cements.	Pyroxylin cements.
Dental alloy.	Refining mineral oils.
Dandelion and digitalis. (Resin of, solid and powdered extracts of).	Refining precious metals.
Disinfectant germicide.	Resin of scammony.
Door checks.	Resorcin.
Dyestuffs.	Salol.
Dimethylglyoxime.	Santonine and strychnine.
Dinitro toluene.	Solid extracts.
Digestive ferments.	Soaps (transparent and liquid).
Diethylaniline.	Shellac varnish.
Ethyl acetate.	Shoe polish.
Ethyl propionate.	Silverware and bronze.
Ethyl butyrate.	Smokeless powder.
Essential oil orris.	Surgical ligatures.
Ethyl chloride.	Soldering flux.
Embalming fluid.	Sodium benzoate.
Eosine.	Sulphonic acid and paraffine.
Ethyl bromide.	Salicylic aldehyde.
Ether.	Solution and solvent of nitro-cellulose.
Ethyl aniline.	Solidified alcohol.
Enamel.	Salophen.
Extracting glycerine from distillery slop.	Saponin.
Filaments for incandescent lamps.	Salicylic acid.
Formaldehyde.	Saccharine.
Formaldehyde.	Shellac thinner.
Gadual.	Stains.
Gelatine capsules.	Sterilizing solution for corks.
Gentian (solid extract).	Silk fabrics.
Glycerophosphates.	Synthetic mustard oil.
Gualacol.	Shampoo, liquid.
Gualacol carbonate.	Shampoo, jelly.

Stencil paper.
Tannic acid.
Tinfoil and bottle caps.
Terpin hydrate.
Textile cleansing soap.
Toluidine.
Transparent paper.
Transparent soap for water-proofing cement.
Trinitrotoluol.

Theobromine.
Thermostatic devices.
Varnish remover.
Viburnum (concentration).
Water colors.
Wood finish.
Wool fat.
Washing lenses.
Wood filler.
Watches.

OTHER FORMULAS

- (2) Pyraline and similar products.
- (2a) Celluloid; pyraline and similar products.
- (2b) Acetic ether; acetphenetidine (conditional); dyes, diethyl barbituric acid (barbital); ethyl sulphate (for use in manufacture of acetphenetidine); phenacetine; pyroxline plastics; ketone; Micheliers; sulphuric ether (in connection with the production of powder); synthetic camphor; trinitrotoluol; viscaloid; white petroleum oils; ethyl sulphate.
- (3) Transparent soap; shampoo; shampoo jelly.
- (3a) Cutting oils; shampoo; shampoo jelly; transparent soap.
- (3b) Liquid soap; shampoo; shampoo jelly.
- (4) Cigars; cigarettes; smoking; chewing tobacco; deodorants.
- (5) Photo enlargements; photoprints; photo-engravings; photographic collodion.
- (6) Fulminate of mercury.
- (6a) Fulminate of mercury.
- (6b) Acetphenetidine; chloral hydrate; dichlorethane; ethyl acetate; ethyl butyrate; ethyl chloride; parafulminate of mercury; paraphenetidine; acetic ether; ethyl bromide.
- (7) Revoked.
- (8) Ethyl chloride; fine chemicals; sulphonmethane; dyes.
- (9) Monobromated camphor; purification of rubber; santonine; strychnine; tannic acid.
- (10) Ethyl acetate (conditional), lacquers, pastes and varnishes from soluble cotton.
- (11) Photographic collodion; photo-engraving; photoprints.
- (12) Imitation leather (see also formula 12a); soluble cotton.
- (12a) Acetphenetidine; barbital; hydrazoanisole; imitation leather; milk protein; paranitrophenol; refining potassium and sodium hydrate; saponification of the waxes of acid-fast bacteria; smokeless powder; terpin hydrate; trinitrotoluol; benzoic acid ethyl ester; dye intermediates; imitation rubber.
- (13) Sulphuric ether. (See also formula 13a).
- (13a) Celery oil; certified food colors; dry extracts for food products; ethereal oil; protargentum; sodium ethyl sulphate; sulphuric ether.
- (14) Ethyl chloride. (See also formula 1 and 8.)
- (15) Ethyl bromide; ethyl chloride; nitrous ether; pure acetic ether.
- (16) B-naphthol; byproducts from distillery slop; glycerophosphates; lacquers for food containers; phenal cinchoninic acid; acetanilid; acid salicylic; acetphenetidine; ammonium; benzonaphthol; betanaphthol benzoate; codeine; diacetylmorphine; ethyl morphine; homatropin; morphine; salicylate cocaine; sodium, strontium; salol. (See also formula 1.)
- (17) Acetphenetidine; chloral hydrate; dichlorethane; ethyl acetate; ethyl chloride; ethylene gas; paraphenetidine.
- (18) Acetate of lime; acetone; vinegar.
- (19) Artificial silk; backing of films; byproducts from distillery slop. (See also formula 16.) Collodion; ethyl acetate; iodizers; solvent for nitrocellulose; photofilms; photo engravings.
- (20) Chloroform (conditional).
- (21) Acetate of lime (conditional).
- (22) For preserving formaldehyde, U. S. P.
- (23) Liniment for external use only.
- (24) Phenacetin; ethyl acetate (conditional); ethyl butyrate; ethyl propionate; ethyl valerate.
- (25) Tincture of iodine, U. S. P.; tr. Iod Fortier, N. F.; tr. Iodine Churchill's; tr. iodine 3 1/2 per cent.
- (26) Ethylaniline and diethylaniline.
- (27) Soap liniment, U. S. P.; chloroform liniment, U. S. P.; liquid and green soap, in accordance with U. S. P. except as to content of camphor and oil of rosemary.
- (28) Motor fuel (conditional).
- (29) Aldehydes (conditional); glacial acetic acid (conditional).
- (30) Chemical and physical laboratory purposes, only in accordance with the provisions of T. D. 2793 (no recovery for re-use); photo dry plates; manufacturing vegetable oils; varnish; white petroleum oils (conditional).
- (31) Tooth paste.
- (31a) Tooth paste.
- (31b) Tooth paste.
- (32) Ethylene (conditional).
- (33) Meat branding inks (conditional).

The term methanol is now used to indicate methyl alcohol.

The types and quality of the denaturing materials used in the preparation of the formulas given are controlled by the United States Internal Revenue Bureau and details as to their specifications may be found in regulations 61, pp. 97-104.

The following table giving the specific gravities and the weight of 1 gal. of the specially denatured alcohols has been found of considerable value to manufacturers:

Specified Formula No.	Weight of 1 Gal. at 15.6° C.	Specific Gravity at 15.6° C.	Specified Formula No.	Weight of 1 Gal. at 15.6° C.	Specific Gravity at 15.6° C.	Specified Formula No.	Weight of 1 Gal. at 15.6° C.	Specific Gravity at 15.6° C.
1.....	6.7793	0.8140	10.....	6.7775	0.8138	21.....	7.8238	0.9394
2.....	6.7731	0.8132	11.....	6.6928	0.8036	22.....	7.0062	0.8412
2a.....	6.7757	0.8135	12.....	6.7937	0.8157	23.....	6.7963	0.8160
2b.....	6.7705	0.8129	12a.....	6.7910	0.8154	24.....	9.0304	1.0843
3.....	6.7771	0.8137	13.....	7.2725	0.8732	25.....	7.0633	0.8481
3a.....	6.7735	0.8133	13a.....	6.6993	0.8044	26.....	6.8539	0.8229
3b.....	6.7487	0.8103	14.....	7.0671	0.8485	27.....	6.8435	0.8217
4 (alt.).....	6.7803	0.8141	15.....	7.1202	0.8549	28.....	6.8186	0.8187
5.....	6.7105	0.8037	16.....	6.7884	0.8151	29.....	6.7810	0.8142
6.....	6.7662	0.8124	17.....	6.7645	0.8122	30.....	6.7498	0.8105
6b.....	6.7796	0.8140	18.....	7.8154	0.9384	31b.....	6.8112	0.8178
8.....	6.7883	0.8150	19.....	6.4745	0.7774	32.....	6.7224	0.8072
9.....	6.7445	0.8098	20.....	7.0149	0.8423			

The Commissioner of Internal Revenue will consider any formula for special denaturation that may be submitted by any manufacturer in any art or industry and will determine (1) whether or not the manufacture in which it is proposed to use the alcohol belongs to a class in which tax-free alcohol withdrawn under the provisions of the law can be used; (2) whether or not it is practicable to permit the use of the proposed denaturant and at the same time properly safeguard the revenue. But one special denaturant will be authorized for the same class of industries, unless it shall be shown that there is good reason for additional special denaturants.

The Commissioner will announce from time to time the formulas of denaturants that will be permitted in the several classes of industries in which tax-free alcohol can be used.

CONCLUSIONS

Users of alcohol should keep in mind that five different formulas (four now that formula 1 is suspended) for completely denatured alcohol have been authorized, which alcohol may be sold, distributed and used without any restriction, regulation or taxes. Formulas for many specially denatured alcohols have been authorized, which formulas are of such a nature as to be suitable for most industries; these alcohols being free of tax but distributed and used under regulation. To those who must use pure ethyl alcohol there are two possibilities. 1. If they desire the alcohol for scientific research only (and a few other cases as mentioned) it may be obtained free of tax, but is subject to Government regulation. The other case is that of manufacturers who may obtain alcohol for non-beverage purposes under Government regulation and pay a tax of \$4.18 per gallon of 95 per cent alcohol.

385 Edgecombe Avenue,
New York, N. Y.

Blast Roasting at Port Pirie*

BY GILBERT RIGG

Metallurgist, Associated Smelters Proprietary, Ltd.

THE introduction of granulated slag into the roaster charge when dealing with Broken Hill lead concentrates has been found to have certain advantages apart from the economy in the use of ironstone, which the slag largely replaces. This practice has been developed at the Port Pirie smelters during the past eight months.

The concentrates used at Port Pirie are divided into two classes, according to their mode of origin; concentrates from the jigs and tables, and slime concentrates from the flotation plants. The following analyses illustrate the composition of the two classes:

	Concentrate Slime			Concentrate Slime	
	Per cent	Per cent		Per cent	Per cent
Pb	63.0	57.0	CaO	1.5	1.5
Zn	7.0	11.0	Al ₂ O ₃	1.5	1.0
S	14.5	18.0	SiO ₂	5.0	3.5
FeO, MnO	6.0	5.5			

A certain amount of oxidized ore is used, and is usually referred to as siliceous ore. The following is an analysis:

	Per cent		Per cent
Pb	20.0	CaO	2.0
Zn	4.5	Al ₂ O ₃	8.0
FeO, MnO	15.0	SiO ₂	40.0

In order to make clear the nature of the present innovation, some account of the roasting practice in general is essential. Roasting is done in two stages, a preliminary or "A" roast on a D. & L. machine, followed by a crushing of the A-sinter, and a final or "B" roast of the A-sinter on Dwight & Lloyd machines or Huntington-Heberlein pots. In both cases the charge is the same and was, until the introduction of granulated blast-furnace slag, substantially as follows:

	Per cent		Per cent
Concentrates	49.0	Limestone	8.0
Slime concentrates	18.5	Ironstone	14.5
Siliceous ore	12.0		

BLAST-ROASTING CHARGE

This charge varied a little in accordance with small variations in the composition of the concentrates.

Originally, the fluxes were crushed through a $\frac{1}{2}$ -in. screen. Experience has shown that this was much too coarse. The notion that coarse pieces in a charge undergoing blast roasting do open up the charge to the passage of the blast is to some extent true. But, on the other hand, such opening up is local, and encourages the blast to pass through the charge at favored spots, while the denser parts of the charge go short. Other factors also militate against this practice. The concentrates, especially the slime concentrates, are finely divided, and, regarded as a uniformly distributed material, would no doubt effectively block the passage of the blast. Such materials, however, have the advantages of their defects. Finely-divided substances, when mixed damp, have a strong tendency to cohere into large and porous aggregates, and in consequence present a relatively coarse structure. The presence of coarse pieces of ironstone and limestone interferes with this process by mechanically breaking down the aggregates during mixing.

Again, seeing that the blast-roasting charge only sinters and never enters the molten condition, pieces of limestone iron $\frac{1}{2}$ in. to $\frac{1}{4}$ in. diameter are attacked only at the surface. They are, however, largely burned to lime, which slakes when the sinter is

*From the *Industrial Australian and Mining Standard*, vol. 62, p. 597 (1919).

exposed to the air, and causes it to crumble and become unsuitable for the blast furnace.

Moreover, the sinter coming from the D. & L. machines on which the final or "B" roast is performed is found to contain the coarser pieces of ironstone in an unaltered condition. The coarse unassimilated material helps to weaken the sinter. The recognition of these facts led the author to use the fluxes in much finer form than before.

In the neighborhood of the limestone quarries on Wardang Island, Spencer's Gulf, are sand dunes composed of disintegrated limestone of the same composition as the solid limestone of which the island is composed. This sand will pass a 40-mesh screen. Substituted for the crushed limestone, it was found to work perfectly. The elimination of sulphur was good, and the final sinter was free from lime as such, and more resistant to exposure.

Ironstone screened through $\frac{1}{2}$ in. gave good results in substantially smaller amount than had been used previously, and owing to the denser character of the charge, it gave a stronger sinter, and, while roasting, gave less trouble through blow-holes and dust losses than previously.

A similar line of action in regard to the crushing of the "A" sinter before passing to the "B" machine or H-H pots was attended with similar results.

The D. & L. sinter derived from this charge averages about as follows:

	Per cent		Per cent
Pb	44 to 45	MnO	3 to 4
Zn	5 to 6	CaO	4 to 5
SiO ₂	9 to 10	S	2 to 3
FeO	16 to 18		

On the blast furnaces this sinter gave satisfactory results, the only addition made on the furnace being a little limestone.

COMPOSITION OF THE SLAG

The composition of the slag corresponding to this sinter is as follows:

	Per cent		Per cent
SiO ₂	21.0	ZnO	13.5
FeO	33.5	Pb	2.0
MnO	4.5	Ag	0.75
CaO	14.0		

The composition of this slag is unusual, and defies any attempt to figure out a silicate formula from it. It runs very fluid and separates well. Microscopical examination of thin slices shows that it is composed of two major constituents. The ground-mass is colorless, in thin section, and resembles fayalite, and is probably a lime-ferrous orthosilicate. Scattered through this is a black to dark brown constituent, with indications of octahedral crystallization; also green octahedral crystals referred to gahnite are present. Frequently the silicate crystals are full of parallel rods, arranged like the teeth of a comb, and suggesting a constituent which separated from the silicate at the moment of freezing of the latter. The slag is decidedly magnetic, the powder being appreciably attracted by a permanent magnet.

Unfortunately time has not yet been available for the final working out and diagnosis of these sections. Arrangements have now been made for a thorough investigation of the problem. In the meantime the following working hypothesis has been adopted:

The silicate ground-mass is an orthosilicate of CaO, MgO, FeO and ZnO. The black to brown mineral is a ferrite (ROFe₂O₃), mainly a ferrite of Zn, possibly

also a ferrite of lime and manganese, or, in other words, a franklinite. These two constituents exist in the molten slag in a state of mutual solution. In addition, it appears that ZnO is also present dissolved in the slag. The orientation of the rods referred to corresponds to the crystallographic structures of the silicate base, and, as suggested, they appear to have separated out at the freezing point of the latter.

STRUCTURE OF THE SLAG

The structure of this slag is of considerable interest, both scientific and technical, and it is expected that its final elucidation will not now be long delayed. Meanwhile, there is some evidence in favor of the foregoing hypothesis. In the first place ferric oxide is present in the slag. Its quantitative estimation is rendered very difficult owing to the presence of 3 per cent of sulphur in the latter, which reduces the Fe to the ferrous state when the slag is treated with acid, but its presence has been qualitatively established. The formation of magnetite under blast-furnace conditions when Fe is present and SiO₂ is deficient is well known. The color and high opacity of the dark constituent and the magnetic character of the slag lend color to the view that a molecule of the construction ROFe₂O₃ is present.

Again, experiments on the use of a reverberatory matte settler yielded large masses of magnetic material which formed on the hearth and side walls and choked up the furnace unless the temperature was maintained high enough to prevent the separation. Incidentally, no matte separated at this temperature either.

INFLUENCE OF ADDING SLAG TO CHARGE

Accepting this hypothesis provisionally, the next question that arose was, what would be the behavior of the ferrite if added to the roaster charge as a substitute for ironstone; in other words, if instead of using new ironstone blast-furnace slag was returned to the furnace. There were several cogent reasons for doing this if possible. In the first place, there is good ground for believing that in the roasting charge ferric oxide serves as a carrier of oxygen to adjacent sulphides. This can only take place if the Fe is absorbed into the sinter. It has already been shown that ironstone in pieces too coarse for this absorption come through the process unchanged, and can be discarded from the charge without injury. The Fe in the slag is already in finely-divided form, and the slag is very easily taken up by the sinter. Further, it was thought that the addition of slag would tend to strengthen the sinter which erred on the side of fragility.

The Zn content of the sinter would naturally be increased by addition of zinc-bearing slag to the charge, and in consequence the blast-furnace slag likewise, and the interesting question arose whether a Zn content could be tolerated in the slag which would make it commercially feasible to treat the latter for recovery of Zn. As regards this amount of Zn upsetting the running of the blast furnaces, this was felt to depend mainly on how completely the sulphur was eliminated from the sinter. With sulphur well below 3 per cent, troubles due to Zn largely disappear. These latter are mainly due to zinky matte and to accretion, in which ZnS plays an important part.

Finally, the economy which would accrue from a reduction in the amount of ironstone required, and the cost of crushing it, were attractive.

Trials with crushed slag had been made some time previously with unsatisfactory results. Granulated slag being available, it was decided to utilize the slag in this form. It seemed to be in an ideal condition for this purpose. It consists of a mass of porous disintegrated grains, the great majority passing readily through a 4-mesh screen and yet free from powder, such as is produced in crushing. Such a material would give the maximum of useful surface and porosity.

LARGE-SCALE OPERATION

After some preliminary small-scale experiments, which were highly encouraging, the substitution of granulated slag for ironstone was put to work on the entire plant, turning out about 400 tons of lead per day. The following charge was used:

	Per cent	Per cent		Per cent	Per cent
Concentrates	40.0	49.0	Limestone sand	8.3	6.0
Slime concentrates	25.5	18.5	Ironstone	4.5	14.5
Siliceous ore	10.0	12.0	Slag	10.0	

For the sake of comparison, the composition of the original charge without slag is given in the second column. It will be noted that the percentage of slime concentrates has been increased in the new charge, this class of concentrate being more difficult to desulphurize than the coarse concentrate under ordinary conditions.

Average figures for the D. & L. sinter from this charge were:

	Per cent		Per cent
Pb	44 to 45	MnO	3 to 4
Zn	7 to 8	CaO	5 to 6
SiO ₂	11 to 12	S	3 to 3
FeO	11 to 13		

This sinter was of good grade and worked well on the blast furnaces. The ZnO content of the blast-furnace slag was 17 per cent and gave no trouble.

INCREASING THE LEAD CONTENT

After running some weeks on this charge, it was decided to try increasing the proportion of concentrates in order to improve the Pb content of the sinter. A supply of siliceous ore not being available at this time, the deficiency in silica was made up by increasing the amount of slag, and adding a silica sand carrying 85 per cent SiO₂. The charge had the following composition:

	Per cent		Per cent
Concentrates	47.0	Ironstone	4.0
Slime concentrates	27.5	Slag	12.5
Limestone sand	7.0	Sand (SiO ₂)	2.0

The charge sintered well, the sinter having the following composition:

	D. & L.	H. & H.		D. & L.	H. & H.
	Per cent	Per cent		Per cent	Per cent
Pb	47.5	48.5	MnO	3.0	3.0
Zn	7.5	7.5	CaO	6.0	5.5
SiO ₂	8.0	8.5	S	2.8	2.7
FeO	13.0	14.0			

Both D. & L. and H. & H. sinter were made from the same charge mixture, the small differences shown being due to slight variations in the constituents. The increased Pb tenor is noticeable. Up to 50 per cent of Pb has been carried without trouble, although before the introduction of the granulated slag 44 to 45 per cent Pb was the limit at which satisfactory sintering practice could be maintained. The equality in S content of both classes of sinter is also of interest, as prior to the introduction of slag the H. & H. sinter usually ran distinctly higher in S than the D. & L.

This sinter ran well in the blast furnaces, the slag having the following composition:

	Per cent		Per cent
SiO ₂	20.7	CaO	12.0
FeO	29.8	ZnO	18.7
MnO	4.8		

The FeO content is 29.8 per cent, as against 33.5 per cent when slag is not used. No Zn troubles were met with.

The next charge run had the following composition:

	Per cent		Per cent
Concentrates	47.0	Ironstone	2.0
Slime concentrates	27.5	Slag	15.0
Limestone sand	7.0	Sand (SiO ₂)	1.5

This also sintered well. The composition of the blast-furnace slag was:

	Per cent		Per cent
SiO ₂	24.2	CaO	11.0
FeO	25.6	ZnO	20.0
MnO	5.3		

This slag ran well, and no Zn troubles were present.

In the foregoing slag analysis the Fe is expressed as FeO, as it also is in the sinters, but part of the Fe is present as Fe₂O₃ in both cases.

No additions of limestone or any other fluxes have been made to the blast furnaces since the slag-sinter was used, the charge consisting of sinter, slag-shells and coke only. The Pb and Ag contents of the slag average 1 per cent and 0.5 oz., respectively.

The use of granulated slag as a constituent of the roaster charge has now been proved. Its advantages may be summed up as follows:

- (1) Better sinter physically, both D. & L. and H. & H.
- (2) Economy in the use of ironstone.
- (3) Economy in crushing ironstone.
- (4) Higher Pb content of sinter, and consequent reduction in cost per unit of Pb roasted.
- (5) Higher ZnO content of slag, which brings its recovery within the limits of commercial practice.

The new slag, while apparently of the same type as the old, differs markedly from it in its higher SiO₂, lower FeO and higher ZnO content. Its further investigation, both from a theoretical and practical standpoint, promises interesting results.

Melbourne, Australia.

Industrial Uses of the Prickly Pear

The prickly pear, more particularly *Opuntia inermis*, or pest pear, is a kind of cactus which already covers about 22,000,000 acres in Australia and is spreading at the rate of a million acres per year. As a reserve food for cattle it has some value, but it is not a well-balanced ration and needs mixing. In Ceylon, India and South Africa it is used as a fertilizer, the broken parts being buried in wide trenches 18 in. deep. This involves considerable labor. The fruits have been used for the manufacture of alcohol in Spain and Sicily, but the enterprise was not commercially successful. For 1 gal. of alcohol 140 lb. of fruit is needed, and to make the enterprise successful ten tons of fruit to the acre would be required and a method of mechanical harvesting not yet invented. As paper-making material the yield of pulp is slight, while the fibers are short and lack felting qualities.

Arsenic pentoxide and arsenic chloride are used for exterminating the plants, and it is found that the cochineal insect has almost exterminated the true pear in India and Ceylon. This plant (*Opuntia monacantha*) is, however, not a serious pest, and the insects will attack no other. Research is in process to discover the action of insects and fungi upon the offending plant.

Synopsis of Recent Chemical and Metallurgical Literature

Improved Methods of Ore Dressing Graphite Ores.

—The *Canadian Mining Journal* for Jan. 16, 1920, contains an article by CHARLES SPEARMAN giving a general outline of ore-dressing methods for graphite ores. In the separation and concentration of graphite from its gangue, the ideal condition is attained when the flake, as a whole, is completely separated from the accompanying gangue and recovered, without material modification to its physical condition, as a concentrated product. The separation is a step in the operation not easily accomplished commercially, but the recovery of the naked flake by concentration is relatively a simple matter; in fact, the treatment of graphite ore is more of a problem in ore dressing than it is one of concentration.

It is advantageous to effect the complete separation of the flake from the gangue previous to concentration. The widespread practice of refining or finishing concentrates necessitates an auxiliary ore-dressing unit.

Prior to the commercial application of flotation to graphite ore, the usual ore-dressing plant was crude and inefficient and it is doubtful if any of them were operated at a profit. The ore was first dried "bone dry" in kilns and crushed in rolls, the drying operation being necessary to prevent "pancaking" of the ore on the face of the rolls. After crushing, the product was delivered to a set of "heavy-duty" rolls for further comminution and then delivered to a series of finer rolls, usually of the flour mill type. The product of the fine rolls was screened between sets with the object of removing the flake graphite as oversize. Some mills of this type were equipped with as many as ten sets of rolls and screens, with the result that most of the flake was completely disintegrated before reaching the final screen.

The screens removed the oversize, which consisted of naked flake, flake with adhering gangue, mica and free gangue. The oversize was refined or finished in auxiliary units, which consisted of fine rolls and French buhr stones which disintegrated the brittle gangue and incidentally the graphite flakes. The product of this operation was screened to remove the undersize, the oversize being commercial flake. Quite often dry tables were included in the circuit in order to relieve the burden on the screens and rolls and to recover additional flake. The dust-laden atmosphere attending these operations is a very serious objection.

The commercial product resulting from this method of concentration is thin, flattened and polished flakes, in which the physical structure of the original flakes is rendered discontinuous due to the action of the rolls. And the ordinary handling of this product results in an abnormal quantity of the lower grade flake.

Recent practice in the separation of the flake from the accompanying gangue is less complicated than the method described and is more efficient in that it produces a higher grade product at a lower cost.

The drying of the ore is eliminated and after preliminary crushing the ore is fed to a ball mill and ground wet. The load and feed of the mill is so adjusted as to insure a free discharge and to exclude

the liberated flake from the zone of disintegration as soon as possible. This action is sometimes accelerated by the addition of oil to the feed to the ball mill, which then acts on the principle of the Macquestin tube section. The pulp from the ball mill is fed to a mixer and then to an Alderson hydraulic classifier, from which most of the gangue-bound flake is returned as oversize to the mill for retreatment, while the free flake for the most part follows the undersize to a Spearman flotation concentrator.

After concentration the flake is dried and graded, and the portion containing adhering gangue is retreated the same as the classifier oversize. The low-grade product is about 3 to 10 per cent of the concentrate. The remainder of the flake after the removal of the dust is No. 1 crucible stock.

The flake resulting from the improved method of concentration may be described as coherent, thick, "bold" and "rugged," that is, having rough edges and surfaces. It is much higher in carbon and has a higher specific gravity than flake from the roll treatment. This is due to the fact that powdered gangue is impressed into the relatively non-coherent mass of minute flakes which constitute the product of roll treatment.

The special advantages of the wet method of separation applied to graphite ore are lower cost of installation and operation, greater quantity of a high-grade product, better grade, and smaller quantity of low-grade product, the elimination of the dust nuisance and simplicity of operation.

Manufacture of Carbon Electrodes.—The increasing demand for electrodes during the latter part of the war period resulted in the erection of a new plant at Niagara Falls, which has now been finished as the Republic Carbon Co. A description of this thoroughly modern plant will be found in the Jan. 15, 1920, issue of *Iron Age*.¹

The raw materials used are: Anthracite, coke, petroleum coke, retort carbon, hard and soft pitch, tar and oil. After preliminary crushing, the coal or cokes are calcined in specially designed electric furnaces, and transferred by belt conveyors to the grinding building, which is equipped with a Raymond mill and Sturtevant and other types of crushers. By means of blowing and elevating conveyors, the finely ground raw materials are delivered at the top of the mixer building. After screening, the materials pass to a series of storage tanks, from which they may be fed as required to weighing cars which dump into the mixing machines. Here the binders are added and the mass is thoroughly kneaded and then molded into lumps resembling a large cheese. The plastic mass is extended through dies of various shapes in a 3,000-ton hydraulic press.

The last stage in the manufacture is the baking and annealing of the electrodes. In the baking building, there are 28 producer gas-fired baking furnaces operating on the ring principle. The green electrodes are placed in saggars, using coke, coal or sand as packing material. These are then placed in the various compartments of the furnaces and buried in some insulating and protective material. Pyrometric control lating and protective material.

Pyrometric control regulates both the baking and the annealing.

¹"New Plant for Making Carbon Electrodes," *Iron Age*, vol. 105, p. 188, Jan. 15, 1920.

Recent Chemical and Metallurgical Patents

Australian Patents

Complete specifications of Australian patents may be obtained from the Government Printer, Melbourne, one shilling each.

Desulphurizing Ore.—To dispense with hand or mechanical rabbling during desulphurizing of, say, zinc sulphide, the ore is caused to descend in a finely-divided state through an upcurrent of pre-heated air in a narrow zigzag passage formed by inclined shelves within a vertical furnace. The air required for roasting is pre-heated by the hot combustion gases leaving the furnace and is forced through pipes into the lower part of the zigzag passages. The roasted ore falls into chambers, from which it is removed by screw conveyors. A series of pokeholes is arranged in the front wall of the furnace to maintain a free passage for the falling ore. (Australian Pat. 9,269, G. RIGG, Victoria. Nov. 25, 1919.)

Manufacturing Oil Pastes.—To obviate drying the material when preparing oil pastes, such as white lead, from lead precipitates, the precipitate is subjected to the action of sodium biborate or other boracic acid salts in the proportion of not more than eighteen grains or less than seven grains to one pound of wet precipitate. The required quantity of oil is then added, and the mass subjected to mechanical working and mixing, the water being expelled and the oil combining with the precipitate. (Australian Pat. 9,458, H. P. FLETCHER, N. S. W. Dec. 2, 1919.)

Glue and Gelatine.—To produce glue and gelatine from the pith of horns and the bones of cattle, these materials are subjected to a solution consisting of one part hydrochloric acid and eight parts of water for a period of five days. This step is repeated till the material has been treated with five solutions. After being washed for two periods of 24 hr. in two separate baths of cold water, the material undergoes two applications, each of 24 hr. duration, of a solution of 100 lb. lime to 100 gal. of water. Two further washings of cold water are given and the material is then dried and boiled for 12 to 18 hr. The thin liquid, which is skimmed off and dried, comprises pure gelatine, while the thick liquid contains the glue. Sulphuric acid may be used in addition to, or instead of, hydrochloric acid. (Australian Pat. 10,447, J. TURNER, Victoria. Nov. 25, 1919.)

Treatment of Battery Separators.—To render wood suitable for separating positive and negative elements in storage cells, the strips are boiled for an hour in a solution of 4 oz. of washing soda to a gallon of water and after cooling are placed in a dilute solution of sulphuric acid of 1.150 sp. gr. for one hour and finally washed. (Australian Pat. 10,120, L. ROWSON, New Zealand. Nov. 18, 1919.)

Recovery of Metallic Zinc.—To keep within predetermined limits the accumulation of impurities in a cyclic process for the electrodeposition of zinc from solutions obtained by the leaching of wasted ores with sulphuric acid (spent electrolyte), a certain proportion of the zinc-bearing solution is withdrawn from each cycle and an equivalent amount of water is added. The deflected solution is treated with zinc dust

in the presence of a soluble arsenic compound for the precipitation of the cobalt, and the manganese is eliminated by electrolytic oxidation and by treatment with suitable oxidizing agents. The purified zinc sulphate solution is then mixed with barium sulphide for the manufacture of lithopone in the ordinary way. (Australian Pat. 9,442. H. W. GEPP, Victoria, assigned to Electrolytic Zinc Co. of Australia Proprietary, Ltd. Dec. 16, 1919.)

Ore Roasting.—To sulphatize zinc sulphide ore preparatory to leaching with sulphuric acid, the ore is subjected to multi-stage roasting. In the first stage the ore is roasted at a high temperature with a controlled supply of air for partial elimination of the sulphur and to insure a sufficient concentration of the sulphur dioxide for the production of sulphuric acid. In the second the ore is roasted at a lower temperature, preferably 725 deg. C., with excess of air. The iron oxide content of the ore functions as a catalyst converting the sulphur dioxide into the trioxide which is absorbed by the zinc oxide to form sulphate. Alternatively, a more or less complete elimination of the sulphur may be effected in the first stage, and in the second stage, unroasted sulphide may be added to the first calcine. (Australian Pat. 9,224. ELECTROLYTIC ZINC CO. OF AUSTRALASIA PROPRIETARY, LTD., assignee of H. W. Gepp, Victoria. Nov. 18, 1919.)

American Patents

Complete specifications of any of the United States patents may be obtained by remitting 10c. each to the Commissioner of Patents, Washington, D. C.

Benzaldehyde From Toluene by Catalytic Oxidation.—Toluene vapor mixed with air, oxygen or ozone and a certain amount of diluent gases or steam is passed over molybdenum oxide, MoO₃, contained in a tube heated to 500 deg. C. Benzaldehyde is formed according to the reaction:

$$\text{C}_6\text{H}_5\text{CH}_3 + \text{O}_2 = \text{C}_6\text{H}_5\text{CHO} + \text{H}_2\text{O}$$
 (1,321,959; JOHN M. WEISS and CHARLES R. DOWNS, assignors to The Barrett Co.; Nov. 18, 1919.)

Sulphonation With Sulphur Trioxide.—By sulphonating aromatic hydrocarbons in the vapor phase with SO₃ from the contact chambers, the formation of water as a byproduct and the presence of excess sulphuric acid in the sulphonic acid are avoided. The rapidity and degree of sulphonation depend upon many factors, such as temperature, time of contact, concentration of SO₃ in gaseous mixture, the particular hydrocarbon used, and the pressure. The sulphonic acid formed may be treated directly with sodium hydroxide for the purpose of replacing the HSO₃ group by hydroxyl. (1,321,994; CHARLES R. DOWNS, assignor to The Barrett Co.; Nov. 18, 1919.)

Chlorinated Pyroxylin.—The inflammability of pyroxylin may be reduced in the following manner, according to ALEXANDER SCHWARZMAN, of Buffalo, N. Y. Commercial pyroxylin is dissolved in CH₃OH containing 5 per cent acetone. This solution is diluted with CCl₄ and treated with chlorine in the presence of a carrier such as ZnCl₂ or SnCl₄ until from 5 to 8 per cent by weight of chlorine has been absorbed by the pyroxylin. The solvents are removed by evaporation and the chlorinated pyroxylin washed, neutralized and dried in the usual manner. (1,323,792; assigned to Spencer, Kellogg & Sons, Inc.; Dec. 2, 1919.)

Personal

JAY A. CARPENTER, metallurgical engineer, has removed his office from Tonopah, Nev., to 1006 South Hill Street, Los Angeles, Cal., where he has a laboratory for ore testing.

FRANK L. DRIVER, president of the Driver-Harris Co., Harrison, N. J., left on March 6 for a two months' trip through England and France.

A. E. DRUCKER has been appointed professor of metallurgy at the Wisconsin State School of Mines.

L. W. EMERSON has joined the engineering staff of the Chile Exploration Co., and will be at its New York City office, 120 Broadway.

H. F. FISH, formerly in the research department of the Great Western Sugar Co., Denver, Col., has been appointed special research assistant in the joint investigation of the fatigue of metals, by the board of trustees of the University of Illinois. Mr. Fish will be located at Champaign, Ill.

ADOLPH HARVITT, who has been on the research staff of the Davison Chemical Co., Baltimore, Md., sailed for Japan on business connected with the foreign shipments of the company.

J. D. JONES, who since last September has been general superintendent of the Algoma Steel Works, Sault Ste. Marie, Canada, has now been appointed general manager in succession to Captain David Kyle, deceased.

HAROLD E. KETCHUM, for the past three years vice-president in charge of construction for the American Nitrogen Products Co., Seattle, Wash., has been made general manager of the Francis A. Vaughn Manufacturing Co., Milwaukee, Wis., manufacturer of tools and construction equipment. During his connection with the American Nitrogen Products Co. Mr. Ketchum built and equipped the factory at La Grande, Wash., for the production of sodium nitrite, using surface power from Tacoma. He also built a factory for the production of concentrated nitric acid and sodium nitrate at Vancouver, B. C., using surface power in the British Columbia Electric Co. Both of these factories are equipped with the Wielgolaski long-arc furnace.

H. A. LINCX of the engineering staff of the Dorr Co. is on his way to South America. He expects to be gone several months and will visit Peru, Chile and Bolivia. His South American address will be Hotel Londres, Antofagasta, Chile.

ERIC A. LOF of the power and mining engineering department of the General Electric Co., Schenectady, N. Y., sailed for Norway March 11.

W. MOTHERWELL, recently from Broken Hill, Australia, is conducting flotation tests at the 85 Mine, Valedon, N. M.

Judge JOHN BARTON PAYNE of Chicago, chairman of the United States Shipping Board, was selected by President Wilson to succeed Franklin K. Lane as Secretary of the Interior. He assumed his duties March 1.

A. R. STEVENSON has severed his connections with Schaar & Co. and is now with the Deegan Supply Co., Chicago, Ill.

MAXIMILIAN TOCH of New York City has been appointed adjunct professor of industrial chemistry in Cooper Union, New York, and will co-operate in the development of a new 4-yr. day course in industrial chemistry to be started in September.

HARRY VIVIAN has been appointed chief engineer of the Calumet & Hecla and subsidiary companies, succeeding the late Edward S. Grierson.

S. S. VOORHEES, chemist, Bureau of Standards, was operated on for acute appendicitis March 1. His continued improvement is confidently expected.

GEORGE WEINTRAUB, formerly chief chemist of the Rare Metals Co., Perth Amboy, N. J., is now metallurgical chemist of the Standard Chemical Co., Canonsburg, Pa.

FRANK R. WICKS has opened an office and testing laboratory at 1006 South Hill Street, Los Angeles, Cal.

Obituary

Captain DAVID KYLE, vice-president and director of the Algoma Steel Corporation, died of pneumonia following influenza.

EDWARD S. GRIERSON, chief engineer for the Calumet & Hecla Mining Co., died recently at his home in Calumet, Mich., following a long illness from pernicious anemia.

Dr. FRANCIS C. PHILLIPS, who was in charge of the chemistry department, University of Pittsburgh, where he was professor of chemistry for forty years, died at his home in Pittsburgh, Pa., on Feb. 16, of influenza and pneumonia.

Current Market Reports

The Non-Ferrous Metal Market

New York, March 15.—A number of minor changes will be noted in the metal market. In an attempt to enliven the apathetic copper market, producers have offered spot for 18½c.

	Cents per Lb.
Copper, electrolytic.....	19.00
Aluminum, 98 to 99 per cent.....	31@32
Antimony, wholesale lots.....	11.25
Nickel, ordinary.....	43.00
Nickel, electrolytic.....	45.00
Tin, Straits, spot.....	63.00
Lead, New York, spot.....	9.50
Lead, E. St. Louis, spot.....	9.25
Zinc, spot, New York.....	9.05
Zinc, spot, E. St. Louis.....	8.75

OTHER METALS'

Silver.....	os.	\$1.21
Cadmium.....	lb.	1.50
Cobalt.....	lb.	1.50
Platinum.....	os.	150.00
Iridium.....	os.	250.00
Palladium.....	os.	150.00
Mercury.....	75 lb.	89.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled.....	29.50
Copper sheets, cold rolled (over 14 os.).....	31.50
Copper bottoms.....	38.00
Copper rods.....	27.50
High brass wire and sheets.....	25.25
High brass rods.....	23.75
Low brass wire and sheets.....	28.50
Low brass rods.....	29.50
Brass tubing.....	37.00
Brass tubing.....	41.75
Seamless copper tubing.....	33.50
Seamless brass tubing.....	34.50
Seamless brass tubing.....	32.00

SCRAP METALS

	Cents per Lb.
Aluminum, cast scrap.....	22@23
Aluminum, sheet scrap.....	22 @ 22
Aluminum clippings.....	25@26
Copper, heavy machinery comp.....	15 @ 15
Copper, heavy and wire.....	13@14
Copper, light and bottoms.....	12 @ 12
Copper, heavy cut and crucible.....	15 @ 15
Brass, heavy.....	7 @ 7
Brass, casting.....	10 @ 10
Brass, light.....	5 @ 6
No. 1 clean brass turnings.....	7 @ 7
No. 1 comp. turnings.....	11 @ 11
Lead, tea.....	5 @ 5
Lead, heavy.....	7 @ 7
Zinc, scrap.....	4 @ 4

The Iron and Steel Market

Pittsburgh, Pa., March 12, 1920.

There is additional information that production has been increasing and is greatly exceeding both the predictions made by producers and the expectations entertained by consumers two or three months ago. The monthly report of the American Iron and Steel Institute, in which there was a hiatus for the months of September to December inclusive, states that in February 2,865,124 gross tons of ingots were produced by thirty companies which in 1918 contributed 84.03 per cent to the country's total. Counting the number of working days in the month and year and allowing for production by the capacity not reporting, this indicates that in February ingots were produced at the rate of 44,200,000 tons per annum, against a rate of 40,-

650,000 tons for January and an average during the last three months of the old year of somewhat less than 30,000,000 tons. Eventually the steel mills may show an ability to produce more steel than would be expected of them, judged by their output in 1916 plus allowances for new construction since, but on that basis indicated capacity is now in the neighborhood of 50,000,000 tons of ingots per annum. On this basis, the rate of production rose from about 45 per cent on Oct. 1 to about 75 per cent on Dec. 31, averaging about 58 per cent for the three months. By the Institute reports the average was 81 per cent in January and 88 per cent in February, suggesting a March rate of about 95 per cent, having regard to the facts that March is almost invariably a favorable month for production and that the transportation difficulties that interfered with production in February are disappearing. Thus there would be 88 per cent for this quarter, against 58 per cent for last quarter, an improvement of 52 per cent, with still better prospects for the second quarter of the year.

INDICATED OUTPUT OF STEEL LARGER THAN ANTICIPATED

These are much larger outputs than consumers of steel have been expecting. At some times it might be of little consequence to the market observer that consumers of steel misjudged the situation and prospects, but, considering what consumers have been doing in the past three months, bidding up prices on themselves and becoming more anxious to buy as producers were reserved about selling when they wished to catch up with their overdue deliveries, it is a very important thing, marketwise, if consumers were acting upon incorrect premises, yet there can scarcely be a doubt that such has been the case.

The runaway in steel prices has probably gone altogether as far as it is to go, and it now appears that it has affected early deliveries chiefly. The United States Steel Corporation is still on the basis of March 21 or Industrial Board prices. Several large and conservative independents will not, according to the present outlook, quote above 3c. for bars, 3.10c. for shapes and 3.25c. for plates to their regular customers for third quarter deliveries, these prices being \$13, \$13 and \$12 respectively above the Steel Corporation prices, while they are the prices to which these independents gradually mounted in the past few weeks as they closed with their customers for second quarter. The opening for third quarter will probably occur within about thirty days. The Steel Corporation is already largely sold beyond that quarter. The smaller independents, who do simply a prompt business, securing delivery premiums when they can, are not yet thinking of third quarter at all, but as the weeks pass will probably secure smaller and smaller premiums. In sheets the top point for small lots for early delivery seems to have been passed about a fortnight ago, with a 10c. basis for common black as the limit, comparing with 4.35c. in the Industrial Board price schedule.

The bi-monthly settlement of the sliding wage scale of the mills controlled by the Amalgamated Association showed 4.65c. for 26, 27 and 28 gage sheets and \$7.40 for tin plate, as average invoice prices of shipments from the selected mills during January and February. The showing in tin plate is not representative of the industry as a whole, it chancing that the selected mills have been doing a premium business when many others have not, except in selling export tin plate at above the regular \$7 market price. The Steel Corporation is, of course, not represented at all in these settlements.

PIG IRON

The pig-iron market appears to have passed the crest in its great upward movement. Apart from the recent decline of \$1.50 in basic iron, the market for extended deliveries is not lower in the Central West, though there have been slight declines at Buffalo and Philadelphia. The market, however, has been dull and almost stagnant, and the common opinion is that the next general price movement will be downward. An important fact is that the premium on prompt foundry iron, once amounting to several dollars a ton, has disappeared entirely. There is no precedent for pig iron being at a high price and at the

same time showing no premium for prompt delivery. The valley market remains at \$42 for bessemer, \$41.50 for basic, \$42 for foundry and \$43.25 for malleable, prompt or forward, freight to Pittsburgh being \$1.40.

FERRO-ALLOYS

Prompt ferromanganese is a trifle easier, carloads standing at about \$200, while later deliveries, to July 1, bring prices on a scale down to about \$170 for June. Second half remains at \$160, delivered. English has been quoted at \$150, c.i.f., but it is uncertain whether purchases could now be made at the figure. Electrolytic ferrosilicon is \$80@81, delivered, for 50 per cent and \$140 for 75 per cent. Bessemer ferrosilicon is quoted at \$59.50 for 10 per cent, \$62.80 for 11 per cent and \$66.10 for 12 per cent, f.o.b. Jackson or New Straitsville, Ohio. Electrolytic ferrosilicon, 12 to 14 per cent, is now competitive with the blast-furnace ferrosilicon in the case of a number of consumers, and is reported to have sold as low as \$65, delivered.

Chemical and Allied Industrial Markets

New York, March 12, 1920.

Owing to the present high prices and small spot stocks, trading has not been very heavy. Foreign demand is still strong on some of the leading items and it is reported that Europe is destitute of some of these more active materials. The present scale of prices is due to remain until producers can catch up with their contracts and the pressure of the transportation problem can be relieved.

GENERAL CHEMICALS

Sodium nitrite is the outstanding item on the list this week. Last week's quotation of 15@17c. per lb. jumped to 65@68c. This rise was occasioned by the depletion of spot stocks, which have been steadily decreasing during the past few weeks. At present this item is unobtainable in any quantity here in the East, but relief is expected from the West and from shipments from abroad. *Nickel salt, single*, has tightened up slightly and at present is quoted at 16@17c. per lb., while the *double* holds firm at 14c. *Salt cake* has been exceptionally active during the week and with present low supply of spot material the low price came up from \$18 to \$21 per ton. *Ammonia* products are still scarce; quotations remain firm at last week's price, *aqua*, 26 deg., being sold at 8½@10½c. per lb. *White granular sal ammoniac* is still firm at 15@16c. per lb. with very little material obtainable at this price. *Methyl alcohol*, wood, is unobtainable in the market at present. Some small quantities are being transferred to old customers but at extreme prices. In sympathy with alcohol, *formaldehyde* remains scarce and prohibitive in price, 85c.@\$1 per lb. being asked. *Barium chloride* is still firm at \$140@\$150 per ton, with no material changing hands even at this level. Producers are completely sold out and it seems to be the opinion of a good many that this condition will prevail for some time.

COAL-TAR PRODUCTS

There has been no change of importance in this market during the past week. Spot stocks on most of the items remain small and previous price levels are holding firm. Producers are for the most part sold up on contract for periods ranging from three to six months. The future of the spot market, because of this condition, does not look especially bright. All *aniline* products are still practically unobtainable, the most important of these being *dimethyl-aniline*, which is quoted nominally at 90c.@\$1.50, with no material to offer at the top price. *Naphthalene, crushed*, holds firm at 6@8c. per lb., while *flake* is quoted at 7@8c. and the *balls* 8½@10c. per lb. It is the opinion of one large producer that there will be an increase in price during the last half as indicated by decreasing surplus stocks on hand at present.

NAVAL STORES

This market is firmer in prices than it has been for the past few weeks, due entirely to scarcity of supplies. Foreign buyers have not come back in the market with the usual demand owing to a continued unfavorable rate of exchange. *Turpentine* advanced to \$2.05 per gal., against \$1.93 of

last week. This strengthening is due to scarcity in the Southern market, which has had the effect of tightening New York prices. All grades of the *rosins* are decidedly firmer. B-D grades are listed at \$18@18.75, against a low mark of \$17 for last week, while E-I advanced to \$18.90@19.25 and K-H \$19.35@20 per 280 lb. There is no immediate relief in sight until the new crop arrives and in the meantime the large spring paint demand threatens to send prices still higher.

CRUDE RUBBER

Para grades are still on the decline, *upriver* fine going down to 40½@42c., coarse 30½@32c. and *caucho ball* 31@32½c. per lb. *Plantations* had a rise on the strength of the jump in exchange with some slight activity on the part of buyers.

VEGETABLE OILS

This market remained firm throughout the week with some slight fluctuation on *cottonseed*, crude, f.o.b. mill, which finished up at 17½@18c. per lb. There is an impending shortage in the *linseed* branch which threatens to be serious unless the crushers can be relieved by Argentine seed. Quotations are slightly firmer in *tone*, *raw*, *carlots*, being listed at \$1.79, and *boiled*, *carlots*, \$1.82 per gal.

MISCELLANEOUS MATERIALS

A continued active market for the past few months on *feldspar* combined with a series of unfortunate conditions, the latest being the severe weather which interfered with surface mining, has seriously crippled this industry. One large producer is refusing to consider any more contracts for the present even at the Government price of \$18 per ton. The nominal quotation of \$13.50@18 per ton, ground grade, f.o.b. Tennessee and New York State remains firm, although there has been no business, on a large scale, reported at these prices.

The *shellac* market is somewhat easier owing to the increase in sterling. Orange fine is still quoted nominally at \$1.45 per lb. while superfine is listed at \$1.50@1.60 per lb.

No. 1 crucible flake *graphite* dropped 50 per cent following the armistice and has never recovered. The prices quoted in the table may be regarded as delivered prices, approximately the same throughout the country. There are graphite mines in Texas, Alabama, Pennsylvania, etc. In Alabama there are twenty to thirty mines producing No. 1 flake, but only four or five of them are in operation, owing to reduced demand occasioned by the cessation of war. Those companies which have developed or are developing a market for other than crucible graphite stand a better chance for permanency.

Chicago, March 10, 1920.

Apparent apathy on the part of buyers marks trading in all lines, caused probably by the fact that price levels seem too high to justify buying beyond actual current needs. But few price changes of moment are recorded. Continued demand in excess of supply causes pine-tar products to continue their upward trend and a suddenly developed shortage in supply of *sodium nitrite* has provoked a spectacular boost. In general it may be said that, with most materials, production is rather less than normal demand and prices are firm with an upward tendency in most cases.

Chicago's growing importance in the *naval stores* industry is indicated by the recent increase in office space and storage capacity made by the General Naval Stores Co. at this point. Their capacity for business will be trebled by the enlargement.

HEAVY CHEMICALS

Continuous demand by the dye industry coupled with shortage in production and a minimum of imports has forced *sodium nitrite* up to unreasonable levels. From a price of 18c. per lb. in carlots two weeks ago, 50c. is now easily obtained for the small lots available. Some sales were made at an even higher figure and it appears that 50c. will be the minimum for some time to come. *Alkali* products continue their upward trend, as spot stocks are low and export demand is still heavy. *Caustic soda*, solid, is quoted at \$5 cwt., f.o.b. works. The same figure is named for goods from Chicago stock, but supplies are so low as to render

this figure practically nominal. *Bleaching powder* is held at \$3.25 per cwt. at the works, 25c. per cwt. more being asked for small lots for local delivery. Scarcity of *soda ash* has forced the figure up to \$2.50@2.65 per cwt. for spots, with but little less asked on contract. *Sal soda* is also up to \$1.40 per cwt. in carloads.

Conditions remain the same as for the past six weeks in *alcohol*, *ethyl*, 190 proof, being quoted at \$5.50@5.70 in barrels, *methyl*, 97 per cent, at \$2.40@2.60 per gal. and *denatured*, 180 proof, at 78@83c. Spot stocks are almost out of existence and these quotations in most instances are purely nominal. The same is true as concerns *formaldehyde*, what little trading occurred ranging from 60@80c. with the most recent offer being made at 70c. New interest is being shown in *blue vitriol* (copper sulphate), producers showing no anxiety to close at the current figure of \$9 per cwt. in carlots. *Chlorine* in cylinders holds at 9c. per lb. in spite of light demand, heavy withdrawals on contracts leading to the expectation of a better selling market. *Sodium bichromate* is easier, current transactions in small lots going at 39c. per lb. f.o.b. Chicago. A shortage has recently developed in *white sal ammoniac*, present market being 20c. per lb. for spots.

Acids, as for some time past, show but little activity, prices holding firm without change. The only exception is in *boric*, which steady demand has forced up to \$16 per cwt. in cars for immediate delivery.

COAL-TAR PRODUCTS

Supply conditions are steadily improving and as a result most prices should soon recede. This does not mean the market is weak. Rather, better supply and lower prices will make trading more active, buyers having stayed out of the market as much as possible during the recently prevailing poor buying conditions. Quotations of 30c. per gal. is still asked for *benzol* for spot shipment, 27c. for contract. *Toluol* is quoted at 28c. in carload quantities. Stocks of *anilines* are still seriously depleted, the oil being quoted at 35c. per lb. and *salts* at 50c. for immediate delivery. *Dimethylaniline*, *diphenylamine* and *paranitraniline*, being completely off the market, are not quotable. *Salicylic acid* has advanced, with present quotations 50c. per lb. for technical grade and 60c. for U. S. P. *Benzoic* remains unchanged at 75c. for technical and 90c. for U. S. P.

VEGETABLE OILS

Practical cessation of export trade has caused accumulation of excess stocks in all lines and induced a falling market. Plentiful supply with demand poor, is the case on every item. *Cocanut oil* is off 2c., *manila*, in sellers' tanks, f.o.b. coast, being quoted at 17c.; refined, in barrels, at 20c. f.o.b. Chicago. *Prime corn oil*, in tanks, is bringing 15c. f.o.b. Chicago, with no inquiries being made for inferior grades. *Cottonseed oil* is very weak, carload quotation on crude being 15½@16c. and on *prime summer yellow*, 18@19c. delivered. Refined, in barrels, is going slowly on the local market at 23c.

A peculiar twist has developed in the *linseed oil* market. At the same time the wholesale market shows a cut from \$1.75 per gal. to \$1.65 per gal. for carlots, jobbers have raised their price on less than 5-bbl. lots 2c. per gal., \$2.05 being the present price. It does not seem that this high price on small quantities can be maintained very long. *Soya bean oil* shares in the general decline, quotations now being, for tanks, f.o.b. coast, 16c.; for barrels, immediate delivery in Chicago, 17½@18c. and for refined, in barrels, Chicago, 19½@20c.

FLotation OILS—NAVAL STORES

The impending new crop causes buyers to be cautious and demand correspondingly light, but prices continue to ascend. *Turpentine* is now quoted at \$2.30 in cars at Chicago, \$2.42 being asked for barrels. This is an advance of 21c. in two weeks. *Pine oil* is also a little higher, \$1.60 being asked for the small quantity of .933 pure steam distilled available and \$1.55 for the destructively distilled. *Rosin* shows some additional strength, today's Chicago quotation on F grade being \$19.75 per cwt., with other grades in proportion. *Pine tar oil* is held at 40c., under excellent demand.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.	\$0.13 - \$0.15	\$0.60 - \$0.65
Acetone.....lb.	2.75 - 3.00	1.16 - 1.18
Acid, acetic, 28 per cent.....cwt.	6.00 - 6.50	3.00 - 3.25
Acetic, 56 per cent.....cwt.	12.00 - 12.50	7.00 - 7.50
Acetic, glacial, 99½ per cent, carboys.....cwt.	12.00 - 12.50	13.50 - 15.50
Boric, crystals.....lb.	14½ - 15½	15½ - 16½
Boric, powder.....lb.	14½ - 15	15 - 16
Hydrochloric.....lb.	08 - 09	09 - 10
Hydrofluoric, 52 per cent.....lb.	12 - 12½	14 - 16
Lactic, 44 per cent tech.....lb.	11 - 11½	12 - 16
Lactic, 22 per cent tech.....lb.	05 - 06	05½ - 07
Molybdic, C. P.....lb.	06 - 07	4.25 - 5.00
Nitric, 40 deg.....lb.	06½ - 07	07½ - 08½
Nitric, 42 deg.....lb.	06½ - 07	08 - 09½
Oxalic, crystals.....lb.	35 - 40	43 - 45
Phosphoric, Ortho, 50 per cent solution.....lb.	24 - 25	40 - 50
Picric.....lb.	30 - 35	2.60 - 2.65
Pyrogallol, resublimed.....lb.	2.50 - 2.55	2.60 - 2.65
Sulphuric, 60 deg., tank cars.....ton	17.50 - 22.00	
Sulphuric, 60 deg., drums.....ton	22.00 - 25.00	
Sulphuric, 66 deg., tank cars.....ton		
Sulphuric, 66 deg., drums.....ton		
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	27.00 - 30.00	32.00 -
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	32.00 -	34.00 -
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	35.00 -	40.00 -
Tannic, U. S. P.....lb.	1.35 - 1.45	
Tannic (tech.).....lb.	42 - 55	
Tartaric, crystals.....lb.	69 - 74	
Tungstic, per lb. of WO.....lb.	1.20 - 1.40	
*Alcohol, Ethyl.....gal.	4.80 - 5.50	6.00 - 7.00
*Alcohol, Methyl.....gal.	2.35 - 2.75	
*Alcohol, denatured, 188 proof.....gal.		72 - 78
*Alcohol, denatured, 190 proof.....gal.		70 - 74
Alum, ammonia lump.....lb.	04 - 05	05½ - 06
Alum, potash lump.....lb.	08 - 08½	09 - 09½
Alum, chrome lump.....lb.	15 - 16	18 - 20
Aluminum sulphate, commercial.....lb.	01½ - 02	02½ - 03
Aluminum sulphate, iron free.....lb.	02½ - 03	03½ - 04
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	08½ - 10½	11 - 12
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.	33 - 35	35 - 37
Ammonium carbonate, powder.....lb.	16 - 16½	17 - 17½
Ammonium chloride, granular (white salamoniac).....lb.	15 - 16	17 - 19
Ammonium chloride, granular (gray salamoniac).....lb.	13 - 13½	14 - 14½
Ammonium nitrate.....lb.	10 - 12	06 - 06½
Ammonium sulphate.....lb.	05 -	3.65 - 3.75
Amylacetate.....gal.		10½ - 11
Arsenic, oxide, lumps (white arsenic).....lb.	23 - 24	
Arsenic, sulphide, powdered (red arsenic).....lb.		160.00 - 170.00
Barium chloride.....ton	140.00 - 150.00	160.00 - 170.00
Barium dioxide (peroxide).....lb.	26 - 27	28 - 30
Barium nitrate.....lb.	11 - 12	13 - 14
Barium sulphate (precip.) (blanc fixe).....lb.	03 - 03½	05½ - 06
Bleaching powder (see calcium hypochlorite).....lb.		
Blue vitriol (see copper sulphate).....lb.		
Borax (see sodium borate).....lb.		
Bromine.....lb.	85 - 95	
Bromine.....cwt.	2.00 - 2.05	2.10 -
Calcium acetate.....cwt.		04½ - 05
Calcium carbide.....ton	20.00 - 25.00	30.00 - 40.00
Calcium chloride, fused, lump.....ton	01½ - 01½	02 - 02½
Calcium chloride, granulated.....cwt.	3.50 - 3.75	4.00 - 4.50
Calcium hypochlorite (bleaching powder).....cwt.		1.50 - 1.70
Calcium peroxide.....lb.		75 - 80
Calcium phosphate, monobasic.....lb.		25 - 30
Calcium sulphate, pure.....lb.	06 - 08	09 - 10
Carbon tetrachloride, drums.....lb.	10½ - 11	12 - 15½
Carbonyl chloride (phosgene).....lb.		80 - 1.05
Caustic potash (see potassium hydroxide).....lb.		
Caustic soda (see sodium hydroxide).....lb.	06 - 07	08 - 09
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	28 - 29	30 - 31
Chloroform.....lb.		2.00 - 2.05
Cobalt oxide.....lb.		
Coppers (see iron sulphate).....lb.		
Copper carbonate, green precipitate.....lb.	27 - 28	29 - 31
Copper cyanide.....lb.		65 - 70
Copper sulphate, crystals.....lb.	08½ - 09	09 - 09½
Cream of tartar (see potassium bitartrate).....lb.		
Epsom salt (see magnesium sulphate).....lb.		
Formaldehyde, 40 per cent (nominal).....lb.		85 - 1.00
Glauber's salt (see sodium sulphate).....lb.		
Glycerine.....lb.		24½ - 26
Iodine, resublimed.....lb.	4.10 - 4.30	4.30 -
Iron oxide, red.....lb.	03 - 20	
Iron sulphate (copperas).....cwt.	1.20 -	1.25 - 1.75
Lead acetate, normal.....lb.	12 - 13	14 - 23
Lead arsenate (paste).....lb.		13 - 17
Lead nitrate, crystals.....lb.		70 - 80
Litharge.....lb.	14 - 15	15½ - 16
Lithium carbonate.....lb.		1.50 -
Magnesium carbonate, technical.....lb.		13 - 14½
Magnesium sulphate, U. S. P.....100 lb.	3.40 - 3.55	3.60 - 3.75
Magnesium sulphate, commercial.....100 lb.	3.00 - 3.10	3.10 - 3.25
Nickel salt, double.....lb.	14 -	15 -
Nickel salt, single.....lb.	16 - 17	17½ -
Phosgene (see carbonyl chloride).....lb.		
Phosphorus, red.....lb.		60 - 65
Phosphorus, yellow.....lb.		35 - 37
Potassium bichromate.....lb.	32 - 33	34 - 37
Potassium bitartrate (cream of Tartar).....lb.		56 - 60
Potassium bromide, granular.....lb.		50 - 65
Potassium carbonate, U. S. P.....lb.	60 -	65 - 70
Potassium carbonate, crude.....lb.	26 - 27	28 - 30
Potassium chlorate, crystals.....lb.	16 - 20	21 -
Potassium hydroxide (caustic potash).....lb.	25 - 32	35 - 42
Potassium iodide.....lb.		3.35 - 3.60
Potassium nitrate.....lb.	19 -	21 -
Potassium permanganate.....lb.		\$0.65 - \$0.95

*Nominal quotations.

	Carlots	Less Carlots
Potassium prussiate, red.....lb.	1.00 - 1.05	1.10 - 1.20
Potassium prussiate, yellow.....lb.	.34 - .36	.40 - .70
Potassium sulphate.....ton	\$225.00 -	
Rochelle salts (see sodium potas. tartrate).....lb.		
Salammoniac (see ammonium chloride).....lb.		
Salt soda (see sodium carbonate).....ton	21.00 - 22.00	
Salt cake.....ton		
Silver cyanide (nominal).....oz.		1.25 -
Silver nitrate (nominal).....oz.		.81 - .82½
Soda ash, light.....100 lb.	2.50 - 2.60	3.00 -
Soda ash, dense.....100 lb.	2.70 - 2.75	3.10 -
Sodium acetate.....lb.	.06½ - .07	.07 - .08
Sodium bicarbonate.....100 lb.	2.40 -	2.75 - 3.00
Sodium bichromate.....lb.	.33 - .34	.35 - .36
Sodium bisulphate (nitre cake).....ton	7.00 - 7.50	8.00 - 10.00
Sodium bisulphate Powdered.....lb.	.05½ - .06½	.07 - .07½
Sodium borate (borax).....lb.	.08½ - .08½	.09 -
Sodium carbonate (salt soda).....100 lb.	1.35 - 1.40	1.50 - 1.75
Sodium chloride.....lb.	.10 -	.12 - .14
Sodium cyanide, 96-98 per cent.....lb.	.24 - .25	.26 - .27
Sodium fluoride.....lb.	.14 -	.15 - .16
Sodium hydroxide (caustic soda).....100 lb.	5.00 - 6.00	6.10 - 6.25
Sodium hyposulphite.....lb.		.03½ - .04
Sodium molybdate.....lb.	2.50 -	3.25 -
Sodium nitrate.....100 lb.	3.00 - 3.25	3.75 - 4.00
Sodium nitrite.....lb.		.65 - .68
Sodium peroxide, powdered.....lb.		.30 - .32
Sodium phosphate, dibasic.....lb.	.03½ - .04½	.04½ - .05
Sodium potassium tartrate (Rochelle salts).....lb.	.40 - .42	.43 - .45½
Sodium prussiate, yellow.....lb.	.23 - .29	.30 - .40
Sodium silicate, solution (40 deg.).....lb.	.01½ - .02	.02 - .02½
Sodium silicate, solution (60 deg.).....lb.	.02½ - .03	.05 - .06
Sodium sulphate, crystals (Glauber's salt) cwt.	1.15 - 1.50	1.60 - 2.00
Sodium sulphide, crystal, 60-62 per cent (conc) lb.		.05 - .06
Sodium sulphite, crystals.....lb.	.03½ -	.04 - .06
Strontium nitrate, crystals.....lb.	.25 -	.28 -
Sulphur chloride.....lb.	.05½ -	.06 -
Sulphur, crude.....ton	22.00 -	
Sulphur dioxide, liquid, cylinders.....lb.	.09 -	.10 - .12
Sulphur (sublimed), flour.....100 lb.	3.35 -	3.40 - 3.65
Sulphur, roll (brimstone).....100 lb.	3.20 -	3.30 - 3.40
Tin bichloride (stannous).....lb.	.42½ -	.46 - .50
Tin oxide.....lb.	.50 - .60	.65 -
Zinc carbonate, precipitate.....lb.		.20 -
Zinc chloride, gran.....lb.	.13 -	.13½ - .15
Zinc evanide.....lb.	.29 -	.50 -
Zinc dust.....lb.	.11½ - .12½	.13 - .15
Zinc oxide, dry American.....lb.		.09½ - .12
Zinc sulphate.....lb.	.03½ - .03½	.04 - .04½

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00 - \$1.10
Alpha naphthol, refined.....lb.	1.40 - 1.60
Alpha naphthylamine.....lb.	.40 - .50
Aniline oil, drums extra.....lb.	.34 - .45
Aniline salts.....lb.	.42 - .50
Anthracene, 80% in drums (100 lb.).....lb.	.75 - 1.00
Benzaldehyde (f.f.c.).....lb.	2.00 - 2.10
Benzidine, base.....lb.	1.25 - 1.35
Benzidine, sulphate.....lb.	1.00 - 1.15
Benzoic acid, U. S. P.....lb.	.90 - 1.10
Benzoate of soda, U. S. P.....lb.	.80 - 1.00
Benzol, pure, water-white, in drums (100 lb.).....gal.	.27 - .36
Benzol, 90% in drums (100 lb.).....gal.	.25 - .29
Benzyl chloride, 95-97%, refined.....lb.	.35 - .40
Benzyl chloride, tech.....lb.	.25 - .35
Beta naphthol benzoate.....lb.	.50 - .55
Beta naphthol, sublimed.....lb.	.65 - .80
Beta naphthol, tech.....lb.	.45 - .55
Beta naphthylamine, sublimed.....lb.	2.25 - 2.35
Cresol, U. S. P., in drums (100 lb.).....lb.	.16 - .18
Ortho-cresol, in drums (100 lb.).....lb.	.23 - .25
Cresylic acid, 97-99%, straw color, in drums.....gal.	.95 - 1.10
Cresylic acid, 95-97%, dark, in drums.....gal.	.85 - 1.00
Cresylic acid, 50%, first quality, drums.....gal.	.60 - .70
Dichlorobenzol.....lb.	.07 - .10
Diethylaniline.....lb.	1.40 - 1.50
Dimethylaniline (nominal).....lb.	.95 - 1.50
Dinitrobenzol.....lb.	.26 - .37
Dinitrochlorbenz. l.....lb.	.25 - .30
Dinitronaphthalene.....lb.	.45 - .55
Dinitrophenol.....lb.	.32 - .36
Dinitrotoluol.....lb.	.38 - .45
Dip oil, 25%, tar acids, car lots, in drums.....gal.	.38 - .40
Diphenylamine (nominal).....lb.	.55 - .65
H-acid.....lb.	1.60 - 1.75
Metaphenylenediamine.....lb.	1.15 - 1.80
Monochlorobenzol.....lb.	.12 - .15
Monoehtylaniline.....lb.	1.50 - 1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	.06 - .08
Naphthalene, flake.....lb.	.07 - .08
Naphthalene, balls.....lb.	.08½ - .10
Naphthionic acid, crude.....lb.	.75 - 1.25
Nitrobenzol.....lb.	.14 - .19
Nitronaphthalene.....lb.	.30 - .35
Nitro-toluol.....lb.	.20 - .30
Ortho-amidophenol.....lb.	3.75 - 4.25
Ortho-dichlor-benz. l.....lb.	.15 - .20
Ortho-nitro-phenol.....lb.	.80 - 1.25
Ortho-nitro-toluol.....lb.	.25 - .40
Ortho-toluidine.....lb.	.25 - .45
Para-amidophenol, base.....lb.	2.50 - 3.50
Para-amidophenol, HCl.....lb.	2.50 - 3.25
Para-dichlor-benzol.....lb.	.12 - .18
Paranitraniline.....lb.	1.00 - 1.35
Para-nitro-toluol.....lb.	1.35 - 1.50
Paraphenylenediamine.....lb.	2.15 - 3.00
Paratoluidine.....lb.	1.75 - 2.50
Phthalic anhydride.....lb.	.60 - .70
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.	.12 - .25
Pyridin.....gal.	2.00 - 2.50
Resorcin, technical.....lb.	3.75 - 4.50
Resorcin, pure.....lb.	6.50 - 6.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	.43 - .45
Salicylic acid, U. S. P.....lb.	.55 - .60
Salol.....lb.	.90 - 1.00

Solvent naphtha, water-white, in drums, 100 gal.	gal.	\$0.22	—	\$0.27
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.19	—	.24
Sulphanilic acid, crude	lb.	.25	—	.30
Toluidine	lb.	1.70	—	2.50
Toluidine, mixed	lb.	.45	—	.55
Toluol, in tank cars	gal.	.28	—	.32
Toluol, in drums	gal.	.29	—	.32
Xylidine, drums, 100 gal.	lb.	.44	—	.50
Xylol, pure, in drums	gal.	.37	—	.45
Xylol, pure, in tank cars	gal.	.35	—	.45
Xylol, commercial, in drums, 100 gal.	gal.	.37	—	.45
Xylol, commercial, in tank cars	gal.	.23	—	.27

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow	lb.	\$0.42	—	\$0.45
Beeswax, refined, yellow	lb.	.47	—	.48
Beeswax, white pure	lb.	.63	—	.68
Carnauba, No. 1, (nominal)	lb.	.80	—	.88
Carnauba, No. 2, regular (nominal)	lb.	.65	—	.78
Carnauba, No. 3, North Country (nominal)	lb.	.46	—	.48
Japan	lb.	.17	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	—	—	.10
Paraffine waxes, crude, scale 124-126 m.p.	lb.	—	—	.10
Paraffine waxes, refined, 118-120 m.p.	lb.	—	—	.08
Paraffine waxes, refined, 128-130 m.p.	lb.	.11	—	.11
Paraffine waxes, refined, 133-135 m.p.	lb.	—	—	.13
Paraffine waxes, refined, 135-137 m.p.	lb.	—	—	.14
Stearic acid, single pressed	lb.	.23	—	.26
Stearic acid, double pressed	lb.	.28	—	.29
Stearic acid, triple pressed	lb.	.32	—	.33

NOTE—Quotations on paraffine waxes are nominal.

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940	gal.	\$1.45	—	
Pine oil, pure, dest. dist.	gal.	—	—	.40
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	—	—	.48
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	—	—	.70
Pine tar oil, double ref., sp. gr. 0.965-0.990	gal.	—	—	.38
Pine tar, ref., thin, sp. gr. 1.080-1.060	gal.	—	—	1.60
Turpentine, crude, sp. gr. 0.900-0.970	gal.	—	—	.35
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990	gal.	—	—	.52
Pinewood creosote, ref.	gal.	—	—	

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	\$18.00	—	\$18.75
Rosin E-I	280 lb.	18.90	—	19.25
Rosin K-N	280 lb.	19.35	—	20.00
Rosin W. G.-W. W.	280 lb.	21.50	—	21.75
Wood rosin, bbl.	280 lb.	15.50	—	17.50
Spirits of turpentine	gal.	—	—	2.65
Wood turpentine, steam dist.	gal.	—	—	1.93
Wood turpentine, dest. dist.	gal.	—	—	1.85
Pine tar pitch, bbl.	200 lb.	8.50	—	8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	14.50	—	14.75
Retort tar, bbl.	500 lb.	15.00	—	15.25
Rosin oil, first run	gal.	.93	—	.95
Rosin oil, second run	gal.	.96	—	.97
Rosin oil, third run	gal.	1.10	—	1.15
Rosin oil, fourth run	gal.	—	—	1.18

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	\$0.33	—	
70-72 deg., steel bbls. (85 lb.)	gal.	—	—	.31
68-70 deg., steel bbls. (85 lb.)	gal.	—	—	.30
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	—	—	.23

Crude Rubber

Para-Upriver fine	lb.	\$0.40	—	\$0.42
Upriver coarse	lb.	.30	—	.32
Upriver cauchó ball	lb.	.31	—	.32
Plantation—First latex crepe	lb.	.48	—	.50
Ribbed smoked sheets	lb.	.48	—	.48
Brown crepe, thin, clean	lb.	.45	—	
Amber crepe No. 1	lb.	.46	—	.47

Oils

VEGETABLE

The following prices are f.o.b., New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	\$0.19	—	\$0.20
Castor oil, AA, in bbls.	lb.	.20	—	.23
China wood oil, in bbls.	lb.	.23	—	.25
Cocanut oil, Ceylon grade, in bbls.	lb.	.18	—	.19
Cocanut oil, Cochín grade, in bbls.	lb.	.20	—	.23
Corn oil, crude, in bbls.	lb.	.17	—	.22
Cottonseed oil, crude (f.o.b. mill)	lb.	.17	—	.18
Cottonseed oil, summer yellow	lb.	.18	—	.19
Cottonseed oil, winter yellow	lb.	.22	—	.24
Linseed oil, raw, car lots	gal.	1.79	—	
Linseed oil, raw, tank cars	gal.	1.72	—	
Linseed oil, boiled, car lots	gal.	1.82	—	
Olive oil, commercial	gal.	2.70	—	3.00
Palm, Lagos	lb.	.16	—	.16
Palm, bright red	lb.	.15	—	.17
Palm, Niger	lb.	.15	—	.17
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.22	—	.24
Peanut oil, refined, in bbls.	lb.	.27	—	.28
Rapeseed oil, refined in bbls.	gal.	1.70	—	
Rapeseed oil, blown, in bbls.	gal.	1.60	—	1.70
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.18	—	.23
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.16	—	.20

FISH

Winter pressed Menhaden	gal.	\$1.15	—	
Yellow bleached Menhaden	gal.	1.20	—	
White bleached Menhaden	gal.	1.22	—	
Blown Menhaden	gal.	1.28	—	

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated	ton	\$35.00	—	\$40.00
Barytes, off color	ton	20.00	—	25.00
Blanc fixe, dry	lb.	.04	—	.05
Blanc fixe, pulp	ton	30.00	—	50.00
Casein	lb.	.35	—	.36
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.04	—	.06
Chalk, English, dense	lb.	.04	—	.05
China clay (Kaolin), imported, lump	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered	ton	25.00	—	40.00
Feldspar (nominal)	ton	13.50	—	18.00
*Fluor spar, acid grade, lump, f.o.b. mines	net ton	30.00	—	45.00
*Fluor spar, acid grade, ground, f.o.b. mines	net ton	52.00	—	57.00
Fuller's earth, domestic, powdered	ton	25.00	—	30.00
Fuller's earth, imported, powdered	ton	35.00	—	40.00
Graphite, crucible, 85% carbon content	lb.	—	—	.07
Graphite, crucible, 86% carbon content	lb.	—	—	.08
Graphite, crucible, 87% carbon content	lb.	—	—	.07
Graphite, crucible, 88% carbon content	lb.	—	—	.08
Graphite, crucible, 89% carbon content	lb.	—	—	.09
Graphite, crucible, 90% carbon content	lb.	—	—	.08
Graphite, crucible, 91% carbon content	lb.	—	—	.09
Graphite, crucible, 92% carbon content	lb.	—	—	.09
Graphite, crucible, plus 92% carbon content	lb.	—	—	.12
Pumice stone, imported	lb.	.03	—	.06
Pumice stone, domestic	lb.	.02	—	
Shellac, orange, fine	lb.	1.45	—	
Shellac, orange, superfine	nominal	1.50	—	1.60
Shellac, A. C. garnet	lb.	1.30	—	1.35
Soapstone	ton	15.00	—	25.00
Talc, domestic	ton	20.00	—	60.00
Talc, imported	ton	60.00	—	70.00

*Nominal

Refractories

Following prices are f.o.b. works:

Chrome brick	net ton	75-80 at Chester, Penn.
Chrome cement	net ton	45-50 at Chester, Penn.
Clay brick, lat quality firelay	1,000	38-45 at Clearfield, Penn.
Clay brick, 2nd quality	1,000	33-35 at Clearfield, Penn.
Magnesite, dead burned	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4 1/2 x 2 1/2 in.	net ton	80-85 at Chester, Penn.
Silica brick	1,000	45-50 at Mt. Union, Penn.

Ferro-Alloys

All Prices f.o.b. works

Ferro-carbon-titanium, 15-16% f.o.b. Niagara Falls, N. Y.	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon	lb.	.20	—	.21
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon	lb.	.21	—	.22
Ferro-manganese, 70-80% Mn.	gross ton	160.00	—	175.00
Spiegel-iron, 16-20% Mn.	gross ton	50.00	—	65.00
Ferro-molybdenum, per lb. of Mo.	lb.	2.25	—	2.75
Ferro-silicon, 50%	gross ton	85.00	—	95.00
Ferro-silicon, 75%	gross ton	150.00	—	175.00
Ferro-tungsten, 70-80% per lb. of contained W.	gross ton	45.00	—	60.00
Ferro-uranium, 35-50% of U	lb.	.90	—	1.10
Ferro-vanadium, 30-40% per lb. of contained V	lb.	7.00	—	7.50

Ores and Semi-finished Products

Chrome ore, 35-40% Cr ₂ O ₃	unit	\$0.60	—	\$0.85
Chrome ore, 48% and over	unit	1.00	—	1.25
*Coke, foundry, f.o.b. ovens	net ton	7.00	—	
*Coke, furnace, f.o.b. ovens	net ton	6.00	—	
Petroleum coke, refinery, Atlantic seaboard	net ton	—	—	14.00
Fluor spar, gravel, f.o.b. mines	net ton	—	—	25.00
Manganese ore, 45% Mn and over	unit	.75	—	.85
Manganese ore, chemical (MnO ₂)	gross ton	80.00	—	90.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	7.00	—	10.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	6.25	—	6.75
Uranium oxide, 96%	lb.	2.75	—	3.00
Vanadium pentoxide, 99%	lb.	6.00	—	
Pyrites, foreign, lump	unit	.17	—	
Pyrites, foreign, fine	unit	.17	—	
Pyrites, domestic, fine	unit	.16	—	.17
Ilmenite, 52% TiO ₂	lb.	.02	—	
Rutile, 95% TiO ₂	lb.	.11	—	
Carnotite, minimum 2% U ₃ O ₈ , per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Zircon, washed, iron free	lb.	.10	—	
Monazite, per unit of ThO ₂	unit	42.00	—	

*Government prices.

Structural Steel

Mill, Pittsburgh

Beams and channels, 3 to 15-in.	100 lb.	\$2.45	—	
Angles, 3 to 6-in., 1-in. thick	100 lb.	2.45	—	
Tees, 3-in. and larger	100 lb.	2.45	—	
Plates	100 lb.	2.65	—	
Rivets, structural, 1-in. and larger	100 lb.	4.20	—	
Rivets, coned for boilers, 1-in. and larger	100 lb.	4.30	—	
Sheets, No. 28 black	100 lb.	4.85	—	
Sheets, No. 10 blue annealed	100 lb.	4.00	—	
Sheets, No. 28 galvanized	100 lb.	6.20	—	

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

INDUSTRIAL

Financial, Construction and Manufacturers' News

Construction and Operation

Arizona

HUMBOLDT—The Silver Belt Mining Co. plans to install a 50-ton flotation mill at its silver mine. Ben Rybon, Prescott, gen. mgr.

KOFA—The New King of Arizona Mining Co., Los Angeles, Cal., plans to construct a 20-ton stamp mill with cyanide equipment at its gold mine, here. W. J. Johnson, mgr.

MAYER—The Peck Consolidated Mining Co. plans to construct a 100-ton cyanide plant. A. Anderson, supt.

TUBAC—R. R. Mason, Patagonia, plans to install a 50-ton flotation concentration mill, in connection with the Royal Blue Mine, near here.

TUCSON—The Midland Copper Co. plans to install a 100-ton flotation mill on its North Star property. E. G. Bush, pres.

TUCSON—The Mineral Hill Consolidated Copper Co. plans to install a 300-ton flotation mill at its copper mine. F. G. Farish, genl. mgr.

TUCSON—The Silver Peak Mining Co. plans to install a stamp and concentrating mill at its silver mine. Paul Von Feldt, supt.

California

BIGGS—The city voted \$45,000 bonds to improve the sewer system, including the construction of a sewage disposal plant.

EL MONTE—B. B. Moore, city clk., will receive bids until March 18 for the construction of a sewer system and a circular septic tank, Imhoff type, for the city. Estimated cost, over \$10,000. Olmsted & Gillelen, Hollingsworth Bldg., Los Angeles, engrs.

TURLOCK—The city trustees are having plans prepared for the construction of a sewage disposal plant. Estimated cost, \$10,000. A. M. Jensen, Fresno, consult. engr.

Connecticut

MERIDEN—The Miller Bros. Cutlery Co., 464 Pratt St., will soon award the contract for the construction of a 4-story, 50x90-ft. addition to present plant on Pratt St. Estimated cost, \$50,000. W. T. Arnold, 105 Elm St., archt.

Illinois

CHICAGO—Darling & Co., 4201 South Ashland Ave., have awarded the contract for the construction of three buildings, including a 5-story, 97x100-ft. distillation plant, etc., to Streenreuter Bros., 3020 South Halstead St. Estimated cost \$225,000.

Iowa

CENTERVILLE—The city will soon award the contract for the construction of a sewage disposal plant, etc. R. O. Stephenson, city clk. M. G. Hall, engr.

Maine

ROCKLAND—The Rockland & Rockport Lime Corp. plans to rebuild lime plant which was recently destroyed by fire, entailing a loss of about \$100,000.

Michigan

GREENVILLE—The Moore Plow & Implement Co. is in the market for gray iron foundry and pattern shop equipment.

HOWELL—The Howell Electric Motors Co. is in the market for brass foundry equipment.

Minnesota

ELLSWORTH—E. A. Meester, village recdr., will receive bids until March 26 for the construction of sanitary sewers, disposal works, including a disposal tank, sludge bed, etc. Estimated cost, \$40,000. Drnar & Smith, Globe Bldg., St. Paul, engrs.

New Jersey

HARRISON—Driver Harris Co., Middlesex St., is constructing a 3-story, 52x100-ft. building including an office, spooling and testing room, etc. G. A. Rickert, adv. mgr.

New Mexico

GAGE—Norman Welch, supt., plans to install a 50-ton concentration mill to handle fluorspar, in connection with its fluorspar mine here.

New York

BROOKLYN—Devoo - Reynolds, 460 Smith St., is having plans prepared for the construction of a 6-story, 55x175-ft. paint factory at Smith and Hamilton Sts., and is in the market for chemicals for the manufacture of paint. Fred A. Phelps, Union Bldg., Newark, N. J., archt.

PENN YAN—The city held an election March 16 to vote on \$5,750 bonds to repair sewage disposal system.

SCHENECTADY—The General Electric Co., River Rd., plans to construct a 1-story, 206x600-ft. punch press shop on Central Ave. Estimated cost, \$700,000.

North Dakota

CANDO—The town plans to construct a sewage disposal plant. Estimated cost, \$60,000. Atkinson and Hall, Devils Lake, engrs.

MINOT—The city has awarded the contract for the construction of a sewer system and sewage disposal plant, to G. W. Kewper, Minot. Estimated cost, \$205,000.

Ohio

AKRON—The S. & O. Engraving Co., 330 South High St., is having plans prepared for the construction of a 2-story, 40x150-ft. office and laboratory building on High St. Harpster & Bliss, Nantucket Bldg., archts. Mayer & Valentine, Bangor Bldg., Cleveland, engrs.

CINCINNATI—The Standard Silicate Co. has purchased a 24-acre site on Pad-dock Rd. and plans to construct a factory on same. Estimated cost, \$750,000.

CLEVELAND—The Buckeye Brass Co., 6410 Hawthorne Ave., has awarded the contract for the construction of a 1-story, 30x110-ft. foundry, 75x75-ft. furnace room and an 18x35-ft. wash-room on Ashland Rd., to Gometz & Neshkes, 2361 East 61st St. Estimated cost, \$75,000.

NEW PHILADELPHIA—The Weiss McClung Co. plans to build a 1- and 3-story factory for the manufacture of rubber. Estimated cost, \$300,000. W. F. Ferguson Co., 1900 Euclid Ave., Cleveland, engr.

Oklahoma

RED FORK—The Sunlight Carbon Co. has purchased an 8-acre site near here and plans to build a carbon factory for the manufacture of lamps, dry cells, lamp black, etc., on same. Estimated cost, \$100,000.

Pennsylvania

MILLERSBURG—The Alvord Reamer & Tool Co. has awarded the contract for the construction of a 40x60-ft. addition to plant, to H. Helwig, Millersburg. Address W. S. Umberger.

PHILADELPHIA—The Trenton Crockery Co., 106 North 2nd St., has awarded the contract for altering the 5-story, 120x195-ft. factory, to Smith-Hardican, 1606 Cherry St. Estimated cost, \$10,000.

West Virginia

WESTMORELAND (Huntington P. O.)—The West Virginia Glass Co., Huntington, plans to build two additional units to its plant, here.

Wisconsin

MANITOWOC—The Aluminum Goods Mfg. Co., 15th and Franklin Sts., had preliminary plans prepared for the construction of a 2-story, 60x350-ft. rolling mill on Main St. Estimated cost, \$500,000. Lockwood, Greene & Co., South Dearborn St., Chicago, engrs.

Ontario

SAULT STE. MARIE—The Natl. Electric Products Ltd., 83 Church St., Toronto, plans to build a 1-story factory for the manufacture of liquid oxygen. Estimated cost, \$25,000.

SUDBURY—The High School Bd. is having plans prepared for the construction of a 2- or 3-story high school. Equipment for chemical and physical laboratories will be installed in same. Estimated cost, \$200,000. P. J. O'Gorman, archt.

WOODSTOCK—John Morrison, city clk., will receive bids until March 24 for the construction of a 1,500,000-gal. sewage disposal plant. Imhoff style, etc. F. J. Ure & Son, engrs.

Coming Meetings and Events

THE AMERICAN ASSOCIATION OF ENGINEERS will hold its fifth annual convention at the Planters Hotel in St. Louis, May 10 and 11.

THE AMERICAN CHEMICAL SOCIETY will hold its annual meeting April 13 to 16 inclusive, in St. Louis. Headquarters will be at the Hotel Statler.

THE AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting in Boston, April 8, 9 and 10. Headquarters will be at the Copley-Plaza Hotel.

THE AMERICAN ELECTROCHEMICAL SOCIETY, NEW YORK SECTION, will hold a meeting on March 26, the subject of which is "Peace Uses for War Products."

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its semi-annual meeting in Montreal, June 21 and 22; Ottawa, June 23; Shawinigan, June 24 and 25, and La Tuque, June 26.

THE AMERICAN IRON AND STEEL INSTITUTE will hold its spring meeting May 23 at the Hotel Commodore, New York City.

THE AMERICAN PETROLEUM LEAGUE will hold a meeting in Chicago, March 26 to 29.

THE CHEMICAL SOCIETY OF THE COLLEGE OF THE CITY OF NEW YORK is pleased to announce the following lectures for the spring semester of 1920 to be delivered in the Doremus Lecture Theatre: "Helium," Monday, March 29, at 4 P.M., Dr. R. B. Moore, chief chemist, U. S. Bureau of Mines (*Lantern*); "Romance of Leather Making," Tuesday, April 13, at 4 P.M., E. A. Brand (*Lantern*); "Water Supply and Drainage in War Cantonnements," Wednesday, April 21, at 4 P.M., Prof. D. D. Jackson, administrative head, department of chemical engineering, Columbia University (*Lantern*); "Modern Coke and Gas Manufacture" (Koppers Process), Thursday, April 29, at 4 P.M., E. L. Crowe (*Lantern and cinema*); "Chemical Naval Warfare," Friday, May 7, at 4 P.M., Prof. James Kendall, professor of chemistry at Columbia University; "Fighting Fire—Fire-foam," Friday, May 14, at 4 P.M., F. A. Epps, chief engineer, the Foamite Fire-foam Co. (*Experimental, cinema and lantern*).

INSTITUTE OF METALS DIVISION OF THE A.I.M.E. will hold its usual joint meeting with the American Foundrymen's Association at Columbus, Ohio, during the week beginning Oct. 4.

THE IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 6 and 7, 1920, at the House of the Institute of Civil Engineers, Great George St., London, S. W. 1. The retiring president, Eugene Schneider, will induct into the chair Dr. J. E. Stead, the president-elect.

THE MINING SOCIETY OF NOVA SCOTIA has planned a meeting for May 4 and 5 which will be held in Glace Bay.

THE NATIONAL FERTILIZER ASSOCIATION will hold its twenty-seventh annual convention at the Greenbrier, White Sulphur Springs, W. Va., the week of June 21.

THE NATIONAL FOREIGN TRADE CONVENTION will be held in San Francisco, May 12 to 15. Chinese delegates have chartered the S. S. Ecuador for transportation to this conference.

THE PENNSYLVANIA SAFETY CONGRESS for 1920 will be held at Harrisburg, Pa., March 21 to 25 inclusive.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its national spring convention March 24 to 26 at the Bellevue-Stratford Hotel, Philadelphia.

THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its spring meeting at the Hotel Waldorf and the Hotel Astor, New York City, April 12 to 16.